

**AN EVALUATION OF TEACHER UTILISATION OF ‘STEP IN NEW PRIMARY
MATHEMATICS GRADE 7’ TEXTBOOK IN MASHONALAND EAST PROVINCE OF
ZIMBABWE.**

by

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DECLARATION

I, O. Mumanyi, declare that **AN EVALUATION OF TEACHER UTILISATION OF ‘STEP IN NEW PRIMARY MATHEMATICS GRADE 7’ TEXTBOOK IN MASHONALAND EAST PROVINCE OF ZIMBABWE** is my own work and that all the sources that I used or quoted have been indicated and acknowledged by means of complete references.

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ABSTRACT

The study describes and evaluates how Grade 7 teachers in the Mashonaland East Province of Zimbabwe used the *Step in New Primary Mathematics Grade 7* textbooks in their teaching, and the impact it had on mathematics teaching and learning. The purpose of the study was to investigate how the teachers used the mathematics textbooks and to suggest areas of improvement. These textbooks were distributed to all the primary schools in Zimbabwe in 2010, under the donor-driven Education Transition Fund. This curriculum initiative sought to address the severe textbook shortage and to improve the performance of the learners. The study examined the ways the teachers interacted with and mediated the textbooks in mathematics lessons, what material they used or did not use from the textbook, how they used it, and why they used it in the specific ways. In order to achieve this objective, an empirical study of a sample of grade 7 teachers in the province was undertaken. Social constructivism was the main theory that guided the study. Stratified purposeful sampling was employed to select three out of eight districts in the province, and to select eighteen schools from the three districts for participation in the study. Each district contributed the same number of questionnaire respondents (n=30) and interview respondents (n=2). A mixed methods design, which combined a questionnaire, a semi-structured interview and non-participant lesson observation, was adopted. The results indicated that the use of these textbooks raised the teachers' and learners' motivation, created some opportunities for teacher learning, and improved the learners' performance in mathematics. However, the teachers' low confidence levels in teaching some topics, the absence of regular staff development programmes, and also textual errors had a negative effect on how the textbooks were used. The teachers did not cover all the textbook content, neither did they demonstrate or encourage the learners to use alternative strategies to solve the problems in the textbooks. A number of teachers showed resistance to the use of these textbooks. This study provided evidence that points to an urgent need for the improved quality of mathematics textbooks, as well as an improvement in the teachers' competencies, namely by placing greater emphasis on the use of textbooks in pre-service and in-service teacher training programmes. Based on the results of the study, a framework for teachers' effective resource utilization is proposed.

KEY WORDS:

composite class, constructivism, Education Transition Fund, evaluation, impact, mathematics teaching, primary school textbooks, textbook mediation, textbook-use.

DEDICATION

I dedicate this thesis to my family.

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LIST OF ABBREVIATIONS

APEC:	Asia-Pacific Economic Co-operation
CAPS:	Curriculum and Assessment Policy Statement
ETF:	Education Transition Fund
EU :	European Union
ICME:	International Congresses on Mathematics Education
ICT:	Information and Communication Technology
NCTM:	National Council of Teachers of Mathematics
NRC:	National Research Council
SAARMSTE:	South African Association for Research in Mathematics, Science and Technology Education
UNESCO:	United Nations Educational, Scientific and Cultural Organisation
UNICEF:	United Nations International Children's Emergency Fund
USA:	United States of America
ZPD:	Zone of Proximal Development
ZIMSEC:	Zimbabwe School Examinations Council

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CHAPTER 1

BACKGROUND TO THE STUDY

1.1 INTRODUCTION

The textbook is one of the most crucial aspects of the curriculum in the teaching and learning of mathematics, and represents a heavy financial investment. It has been argued that besides qualified teachers, textbooks are the most important resources for effective teaching and learning, and for learner achievement (Christie, 2008; Hindle, 2010; Magagula, 2005). This researcher's experience as a primary school teacher has indicated that textbooks are used extensively in mathematics lessons, in deciding what to teach, how to teach it, and the nature of the exercises or tasks assigned to the learners. Hence it was considered worthwhile to investigate the extent of the use of textbooks by the teachers.

In an effort to improve learner performance in mathematics, and also in other core learning areas, as from 2010 the Zimbabwean government supplied textbooks to all the learners in primary schools. This curriculum intervention programme fell under the auspices of the Education Transition Fund (ETF). Accordingly, by May 2010 the European Union (EU), the United Nations International Children's Emergency Fund (UNICEF), and other donor governments had provided funds in excess of US\$60 million. Using this fund the Zimbabwean government, in collaboration with UNICEF, sourced more than 13 million textbooks for primary schools as part of its effort to address the shortage of resources in the schools. This move resulted in a learner-textbook ratio of 1:1 for the 4 core subjects (Coltart, 2010). *Step in New Primary Mathematics Grade 7* is the textbook that is used by the grade 7 teachers for teaching mathematics (Logan & Tambara, 2010b).

In some primary schools this was the very first time that all the learners had a set of textbooks. And as far as the teachers were concerned, this was also the very first time they had to teach classes where every learner had a mathematics textbook. The demand situation prior to the roll-out of textbooks will be briefly described in the next two paragraphs.

The shortage of textbooks in Zimbabwean schools prior to the launch of the ETF in 2010 is widely documented. The then Minister of Education, Sport, Art and Culture, Coltart (2010), indicated that in some Zimbabwean schools only the teacher had a textbook. The rural schools were the most affected in terms of textbook shortages. Coltart (2010, p.3) noted that“...the current pupil-to-textbook ratio is 1:10, while 20% of primary schools in rural areas have no textbooks at all for English, mathematics or local languages.” The shortage of textbooks made it difficult for the teachers to cover the syllabuses, as they had to move at a slower pace; plus, it placed an extra work load on the teachers because they had to transfer what was in the textbook onto the chalkboard in order for all the learners to see, copy and do the work. One primary school teacher put it this way, “It was difficult to give homework when several learners in a class shared a single textbook: for example, who takes the textbook home?” The shortage of textbooks had a negative impact on the quality of education, particularly in the primary schools, since the learning at primary level is foundational to all subsequent levels. The provision and integration of textbooks during these years is central to the achievement of quality education.

Chakanyuka, Chung and Stevenson (2009, p.52) conducted a study to assess the state of affairs in primary and secondary schools in Zimbabwe. One of their objectives was to do an audit of textbooks for the core learning areas, namely English, the local languages and mathematics. Their findings on the textbook supply situation in sample rural and urban primary schools are presented in Tables 1.1 and 1.2.

Table 1.1: The adequacy of textbooks, in %, in sample rural primary schools, 2009.

	Range of ratios of textbooks: number of learners				
	1:1-1:2	1:3-1:4	1:5-1:8	1:9 and above	No textbooks
English	26.0	14.0	18.9	31.4	9.7
Local languages	19.9	11.8	11.6	41.2	15.4
Mathematics	22.2	15.6	17.5	37.0	7.7

Table 1.1 shows that only 26.0% (English), 19.9% (local languages) and 22.2% (mathematics) of the sample rural primary schools had adequate textbooks at ratios of one or two learners per textbook. The rest of the schools (approximately 80%) had inadequate textbooks. In some schools eight or nine learners shared one textbook, while in others there were no textbooks at all.

Table 1.2: The adequacy of textbooks, in %, in sample urban primary schools, 2009

	Range of ratios of textbooks: number of learners				
	1:1-1:2	1:3-1:4	1:5-1:8	1:9, and above	No textbooks
English	40.6	20.7	9.7	18.4	10.6
Local languages	42.9	13.4	12.4	22.6	8.8
Mathematics	37.3	16.1	14.7	20.7	11.1

Table 1.2 shows that 40.6% (English), 42.9% (local language) and 37.3% (mathematics) had adequate textbooks, with ratios of one or two learners per textbook. The textbook supply situation in the sample urban primary schools was better than that in the rural primary schools.

The two tables indicate that the shortage of textbooks was more pronounced in the rural than in the urban schools, and that the supply of mathematics textbooks was far from adequate. Some rural and urban schools had no textbooks at all.

1.2 THE RESEARCH PROBLEM

There is little information available on the use of mathematics textbooks by teachers in teaching and learning in the primary schools. Not many studies have focused on how teachers in developing countries like Zimbabwe use mathematics textbooks in the classroom environment. Mohammad and Kumari (2007) expressed concern that the existing literature sheds little light on the teacher-textbook relationship. They cited Lebrum et al. (2002, p.71) who noted that "...the literature is deafening in its silence on classroom methods of the use of textbooks by elementary

school teachers and, indeed, by high-school teachers.” Concern has been raised that the use of mathematics textbooks is under-researched (Fan, Chen, Zhu, Qiu, & Hu, 2004; Lee, 2011; McNaught, Tarr & Sears, 2010). Furthermore, it has been argued that, compared to other fields of research in mathematics education, research on the use of mathematics textbooks is at an early stage of development, and that more attention should be directed at this important area (Fan, 2011; Fan, Turnau, Dole, Gelfman & Li, 2004; Nicholls, 2005). To this end, the National Research Council (NRC) (2004) recommended that research should focus on the teachers’ implementation of the curriculum, with special reference to textbook use. Thus there is a call for research focusing on how teachers use mathematics textbooks, and for a greater use of empirical methods where data can be collected and analysed in a systematic manner.

One of the reasons for this limited number of studies on the teachers’ use of mathematics textbooks is, according to Fan (2011, p.2), that “...the philosophical foundation, theoretical framework, and research methods for disciplined inquiry on different issues in mathematics textbook research are still lacking or fundamentally under-developed.” This, however, could be a contestable statement nowadays, given the proliferation of research that has been done in the past decade or two. A similar view as the above was expressed by Rezat (2006), who attributed the dearth of research into the use of textbooks to the lack of an appropriate theoretical framework for textbook use. Fan and Rezat argue that few studies on textbook research have employed scientific research methods, and that many of these studies mainly focused on the analysis, and/or comparisons of textbooks. Remillard (2005) observed that mathematics is a subject that has historically relied heavily on textbooks; therefore, the field of mathematics offers a fruitful opportunity to examine how teachers use textbooks in teaching and learning. It is necessary to examine how well mathematics is taught in the primary school, and this includes looking into the use of mathematics textbooks, and where possible, to recommend improvements.

Consequently, the past few years have witnessed an increased attention and interest in research on the use of mathematics textbooks, although this has been largely skewed towards practices in developed countries, and in lower primary school grades, or the high school. Examples of this increased interest in mathematics textbook research are the annual conferences of the Southern African Association for Research in Mathematics, Science and Technology Education

(SAARMSTE), the International Congresses on Mathematics Education (ICME) and the Asia-Pacific Economic Co-operation (APEC) grouping, which have assigned discussion groups and group sessions to focus on mathematics textbook themes since 2008 (Fan, 2011).

One result of Discussion Group 14 at the 2004 ICME deliberations was the identification of several proposals for research on mathematics textbooks. Some of the questions that have been raised are: “How do textbooks shape the teaching and learning of mathematics within classrooms, for better or worse, and to what extent? How do teachers and students use mathematics textbooks, and why?” (Fan et al., 2004, p.486).

This study describes and evaluates the ways that grade 7 teachers in the Mashonaland East Province of Zimbabwe use the *Step in New Primary Mathematics Grade 7* textbooks. Hitherto there had been no empirical evidence known to the researcher to show how well these textbooks have been used, and how this intervention impacted on the teaching and learning of mathematics at grade 7 level.

Without knowledge of how textbooks are used in the classrooms, it is difficult to come up with appropriate teacher support programmes that will empower them to meet the challenges they face in their day-to-day work, and in their efforts to help students to learn mathematics meaningfully.

1.3 THE RESEARCH QUESTIONS

The study was guided by the following research questions:

1. In what ways do grade 7 teachers use the *Step in New Primary Mathematics Grade 7* textbooks in their teaching?
2. What factors influence how the grade 7 teachers use the mathematics textbooks?
3. What impact has the use of the *Step in New Primary Mathematics*

Grade 7 textbooks had on the teaching and learning of mathematics?

1.4 AIMS AND OBJECTIVES OF THE STUDY

The aim of the study was to describe and evaluate how the teachers in the Mashonaland East Province of Zimbabwe use *Step in New Primary Mathematics Grade 7* textbooks in their teaching.

The main aim was sub-divided into the following objectives:

- to explain how teachers use the textbooks, or the teacher-textbook-learner interactions that occur in the classrooms;
- to identify and explain the teacher factors that influence how they use the mathematics textbooks; and
- to establish what impact, if any, the use of these textbooks has had on the teaching and learning of mathematics.

1.5 THE SIGNIFICANCE OF THE STUDY

How the teachers use these donor-funded textbooks is topical and valuable research in Zimbabwe, given the fact that there had been a critical and sustained shortage of textbooks in the majority of the schools. Considerable donor and government investment went into the provision of new textbooks (see section 1.1). Now that there were adequate numbers of textbooks in the core subjects (Coltart, 2010), it was pertinent to find out how they are used, as well as their impact on the teaching and learning of mathematics at grade 7 level.

To the researcher's knowledge this is the first study of this nature, namely that investigated how the teachers of grade 7-learners in Zimbabwe use these ETF mathematics textbooks in their teaching and learning. Previous studies on teachers' textbook use have mostly been conducted in developed countries, or outside Africa. Some examples of these studies are discussed in the

literature review in Chapter 2 (see section 2.4). This study fills the gap by describing and evaluating how teachers use the mathematics textbooks at grade 7 level, and specifically in a developing country.

Teachers are central to any curriculum improvement effort because the implementation of the curriculum takes place in the classrooms (Ornstein & Hunkins, 2004). The provision of new mathematics textbooks in Zimbabwe was a curriculum intervention programme, requiring from teachers to implement it. This study investigates how the teachers made use of the textbooks in the mathematics classrooms.

Findings from this study could be valuable to other countries where new curriculum projects have been introduced, for example the Curriculum and Assessment Policy Statement (CAPS), in South Africa, and the Textbooks for a Global Society initiative, in Namibia. This is because new textbooks were integral to the implementation of these 2 curriculum projects. For example, a renewed emphasis could be placed on the pre-service and in-service professional development of the teachers, focusing on how they may more effectively make use of these textbooks in teaching mathematics.

In respect of the outcomes of this study, valuable insights were gained that can guide existing policies and practices (Elsaleh, 2010; McNaught et al., 2010; Remillard, 2005). This view is supported by Remillard and Bryans (2004), who believe that such research brings about a better understanding of how teachers engage with curriculum materials like textbooks, which could contribute to teacher development efforts and to a discussion of methods for effective textbook use. For instance, they cited Bruner (1977) who argued that the curriculum (or textbook) is geared more towards the teachers than towards the learners, and that "...if it cannot change, move, perturb, inform teachers, it will have no effect on those whom they teach. If it has any effect on pupils, it will have it by virtue of having had an effect on teachers" (Remillard & Bryans, 2004, p.352). It is the researcher's view that teacher educators will also gain new insights into how best to prepare the future teachers in the use of textbooks.

Furthermore, McNaught et al. (2010) pointed out that studies on how mathematics textbooks are used can inform the decisions of the school personnel, curriculum developers and policy makers

in respect of the curriculum. For example, the needs and concerns of the teachers regarding the use of *Step in New Primary Mathematics Grade 7* textbooks are highlighted in this study. The National Research Council (NRC, 2004) also alluded to the fact that learner achievement in mathematics is to a large extent influenced by the manner in which the textbook is used. Thus, it is hard to judge the effectiveness of textbooks or to make inferences regarding student learning without any knowledge of how the textbooks are being used.

This study is important because it contributes in informing all the stakeholders how the quality of curriculum reform and the implementation of projects like the ETF can be improved, which in turn may enhance both the ways in which the teachers use the mathematics textbooks, and their impact on the learners. The study adds to the existing mathematics education literature by recommending new possibilities for improving the use of textbooks by the teachers.

1.6 THE SCOPE OF THE STUDY

The study was conducted in three districts situated in the Mashonaland East Province of Zimbabwe, and the schools that participated in the study represent the urban, peri-urban and rural environments that are typical of most of the eight non-metropolitan provinces in the country. Only grade 7 teachers in the schools where the *Step in New Primary Mathematics Grade 7* textbooks were available participated in this study. One Headmaster who volunteered was also informally interviewed as part of the study. Eighteen schools out of the 670 primary schools in the province participated in the study.

The reasons for using this small sample are stated in sections 3.6 and 5.4.

1.7 THE RESEARCH DESIGN

The problem was investigated using the survey research design. Survey research enables the collection of data from a sample of a large population. The survey made use of mixed methods, consisting of teacher questionnaires, lesson observations and teacher interviews (as described in

Chapter 3) was used to describe and evaluate how grade 7 mathematics teachers in Zimbabwe use the *Step in New Primary Mathematics Grade 7* textbooks in their teaching. The use of mixed methods helps to offset the weaknesses of both quantitative and qualitative methods (Creswell, 2012). This approach also helps to provide a more comprehensive understanding of the research problem (Creswell & Plano Clark, 2011; Greene, 2007; Ivankova, Creswell & Plano Clark, 2013). Triangulation was done, which Moon and Moon (2004) say entails the collection of both quantitative and qualitative data simultaneously. The quantitative data were gathered largely from the questionnaires, while the lesson observations and teacher interviews provided the qualitative data.

1.8 DEFINITIONS OF THE KEY TERMS

1.8.1 Constructivist theory

The Constructivist theory is a way of explaining how children learn, and it suggests that children must be active participants in the development of their own understanding. It rejects the view of children being blank slates, or empty buckets that must be filled by the teacher.

1.8.2 Education Transition Fund (ETF)

This donor fund was set up in Zimbabwe in 2009 to ensure that all the children had adequate learning materials, improve learner performance, and build the capacity of the then Ministry of Education, Sport, Art and Culture to deliver basic education (UNICEF, 2013).

1.8.3 Teacher textbook mediation

The ways in which teachers modify, restructure or re-organise the content and tasks in the mathematics textbook. It includes what is omitted, added and emphasised in the textbook by the teacher (Rezat, 2006).

1.8.4 Textbook use

How the teacher (and learner) uses the textbooks, e.g., in reading, answering the questions set in the textbook, adapting such questions, explaining the concepts, looking at and describing pictures/diagrams, setting homework.

1.8.5 Triangulation

The use of more than a single research strategy in one investigation so as to confirm or reject the findings. Triangulation helps in that the limitations of one research strategy are offset by the other strategy or strategies (Greene, 2007; Ivankova et al., 2013).

1.8.6 Triangular activity theory

A simplified model suggested by Rezat (2006), which suggests a relationship between three variables in the use of the textbook, namely the interactions taking place between the teacher, the learner and the textbook, with the teacher as the mediator of the other two.

1.8.7 Composite classes

Classes in which children of different ages and stages are taught within the same classroom. These classes are associated with small rural primary schools where there may be insufficient numbers of children to form separate age-related classes, (Cornish, 2006; Wilson, 2003).

1.8.8 Double-sessioning

A situation where some students attend classes in the morning and the others in the afternoon. They can share the same classrooms, and to some extent, the same textbooks. These schools are a common feature in urban high-density residential areas in Zimbabwe.

1.8.9 Implementation fidelity

The extent of the teachers' adherence to textbook use in classroom instruction. Content-implementation fidelity is "the textbook content used on a continuum from exactly using what is written in the textbook to the extreme of regularly skipping or substituting content"(McNaught et al., 2010, p.2).

1.9 ORGANISATION OF THE STUDY

The research report consists of 5 chapters as outlined below.

Chapter 1: Background to the study.

Chapter one provides background information to the study, the problem statement, the purpose of the study, the research questions that guided the study, the scope, aims and objectives, the significance of the study, a description of the research design, a definition of the key concepts and the organisation of the study.

Chapter 2: The literature review

This chapter discusses several theories, models and recent studies related to the use of the mathematics textbook. The evolution of textbook use, the value of textbooks, and some of the factors that influence how teachers use mathematics textbooks in teaching are also reviewed.

Chapter 3: Research methodology

This chapter focuses on a discussion of the research design: the mixed method research approach, the development of the data-collection instruments, the procedures of data collection, the pilot study, a sample selection for the main study, together with a discussion of the ethical issues, the quality of the data, and the data analysis procedures.

Chapter 4: Data presentation, analyses and discussion

In chapter 4 the data collected from the questionnaires, the interviews with the teachers, and the observations of the lessons are presented, analysed and discussed. Tables are used to present the quantitative data, and descriptions for the qualitative data. The findings of the study are used to answer the research questions.

Chapter 5: Summary, recommendations, limitations and conclusion

This chapter provides a summary of the research, the findings from the literature review and from the empirical study, recommendations for further action and future research, the limitations of the study, and a conclusion.

In the next chapter a review of the related literature is presented.

CHAPTER 2

THE LITERATURE REVIEW

In this chapter the literature review in respect of the study evaluating how teachers in the Mashonaland East Province of Zimbabwe use *Step in New Primary Mathematics Grade 7* textbooks will be presented. The following aspects will be discussed, namely the history of the use of mathematics textbooks (section 2.1), the importance of textbooks (section 2.2), theories and models related to the use of mathematics textbooks (section 2.3), international studies on the teachers' use of mathematics textbooks (section 2.4), factors that influence the teachers' use of mathematics textbooks (section 2.5), the impact of new textbooks on the teaching and learning of mathematics (section 2.6), and what constitutes the effective use of mathematics textbooks in teaching and learning (section 2.7). The chapter ends with a summary.

2.1 THE HISTORY OF THE USE OF MATHEMATICS TEXTBOOKS

The textbook is one of the oldest resources for teaching and learning (Haggarty & Pepin, 2004). Jamieson-Proctor and Byrne (2008, p.295) cited several authorities, for example Fauvel (1991), Gray (1990), and Love and Pimm (1996), who observed that throughout history mathematics textbooks have been synonymous with mathematics education. This observation highlights the importance that has long been attached to mathematics textbooks by the teachers of mathematics.

Robert Record authored some of the earliest known mathematics textbooks since the advent of printing, including one entitled 'The Grounds of Arts', published in 1543 (Jamieson-Proctor & Byrne, 2008). This textbook was written in the form of a dialogue between a master and a scholar. The master used this textbook to teach his scholars in dialogue form the basics of arithmetic, namely counting, adding, subtracting, multiplying and dividing. Record wrote his books in simple and clear English, and this made them appealing to a wider readership, compared to others that were written in Latin or Greek. Record's books were also widely acknowledged because he had "a clear idea of which order the mathematical topics should be taught and wrote his books in that order with the intention to offer a complete course of

mathematical instruction” (Johansson, 2006, p.45). Over the years the traditional textbook has been used in pretty much the same way, except that the textbook quality has improved as a result of improvements in technology.

- **Technology: A threat to the survival of traditional textbooks?**

More recently the mathematics textbook has faced competition, arising from several developments in technology. For example, Vandeveld (1994) noted that in many schools photocopies were insidiously replacing textbooks; thereby threatening the disappearance of the traditional textbook. Other competing technologies are the calculator, the computer and the internet. Technological advances, however, brought several benefits to the mathematics teachers and learners. The National Council of Teachers of Mathematics (NCTM) argues that “Technology is an essential tool for teaching and learning mathematics effectively; it extends the mathematics that can be taught and enhances students’ learning” (Van de Walle, 2007, p.107).

Segoe (2012, p.266) furthermore stated:

Information and communication technology (ICT) services such as video conferencing or satellite broadcasts offer a way to move away from traditional learning, like pre-organised guided learning, towards experiential learning which is based on discovery, active learning and self-organisation.

It is now possible to replace the textbook with an interactive digital manual which offers a combination of the textbook, workbook and study guide. Mohlala (2012) comments that these digital manuals can be used even in areas where there is no internet or wireless network connectivity, by using preloaded external memory cards. Additionally, tablets have become more compact, portable and cheaper. In fact, Rezat (2009) correctly observed that most recent research in mathematics education has focused on the role of these new technologies in the teaching and learning of mathematics, at the expense of research on textbooks and their use.

Notwithstanding these technological developments, the traditional textbook is still an important

tool in the teaching and learning of mathematics. Contemporary teaching is still characterised by a heavy dependence on textbooks (Chambliss & Calfee, 1998; Woodward, Elliott, & Nagel, 1988); and in particular, the teaching of mathematics still relies on the textbook more than any other subject (Johansson, 2006). To this end, Jamieson-Proctor and Byrne (2008) argue that textbooks are a modern-day reality and mainstay in primary mathematics classrooms, where they are used daily by the teachers and the learners. This view is supported in a survey conducted in the United Kingdom which revealed that almost 90% of the schools felt that a set of good textbooks was indispensable and effective to raise educational standards; while only half of the schools felt the appropriate use of new technologies was valuable (Santos, Cruz, & Macias, 2006).

Also, the teachers' reliance on mathematics textbooks has been estimated to be 90% of mathematics lessons, which makes textbooks synonymous with mathematics education (McNaught, 2005). It is therefore no wonder that Howson (1995, as cited in Rezat, 2006, p.1260), argued that new technologies have not overtaken the outstanding role of textbooks. He continued to state that, "Despite the obvious powers of the new technology it must be accepted that its role in the vast majority of the world's classrooms pales into insignificance when compared with that of textbooks."

Askew, Hodgen, Hossain and Bretscher (2010) reported on studies on international comparisons of mathematics attainment in schools saying (a) the use of good textbooks is more important for high attainment in mathematics than factors such as expensive ICT equipment and (b) countries that perform consistently well in mathematics use carefully constructed textbooks as a primary means of teaching.

This researcher believes that Askew et al.'s (2010) and Howson's (1995) arguments are particularly true in developing countries where these new technologies are not easily accessed or afforded, particularly in the rural communities where the majority of the people live. The provision and the use of textbooks are also still necessary because of inadequate teacher training in ICT and the lack of infrastructure that would enable most schools to go digital. Where these conditions exist, the teachers' use of textbooks can be enhanced by the use of these technologies,

but not replaced.

Despite the dominance of textbooks, Jamieson-Proctor and Byrne (2008, p.295) expressed concern that “...very little research carried out in the Australian context, particularly in recent times has been dedicated to examining the efficacy of textbook use in primary mathematics classrooms, nor the reasons teachers rely on them so extensively.” The literature the researcher reviewed also seems to suggest that, in general, little research has been conducted in this area. Therefore, research on how the teachers use mathematics textbooks in teaching and learning is still relevant, especially in the context of a developing country like Zimbabwe.

2.2 THE IMPORTANCE OF TEXTBOOKS

There could be less of a reliance on textbooks in developed countries where other sources of information like the internet exist in abundance, but the same cannot be said in respect of developing countries where the textbook remains the major resource for both the teachers and the learners. Much of the government’s and the donor’s investment has gone into the provision of teachers’ and learners’ textbooks for schools in both developed and developing countries (Lubben, Campbell, Kasenda, Kapenda, Gaoseb & Kandjeo-Marenga, 2003). For example, the Education Market Research (2004, as cited in Reys, Reys & Chavez-Lopez, 2004), reported that in 2001-2002, K-12 school districts in the USA spent over \$4 billion on textbooks, making it the second biggest school expenditure after the teachers’ salaries. In Zimbabwe an amount of US\$60 million was spent on primary school textbooks under the ETF in 2010 (Share, 2010). In developing countries textbooks are a dominant element in the classrooms, next in importance to the teachers, students and physical space (Mohammad & Kumari, 2007). It should be borne in mind that access to or the availability of textbooks is not enough *per se*; how they are used is more important.

Studies by Christie (2008), Hindle (2010) and Magagula (2005) reveal that textbooks set up pedagogic pathways and approaches that help determine relationships between the teachers and the learners which, in turn can have positive effects on the students’ learning. The availability of quality textbooks and other resources such as stationery, space and time has positive effects,

which help the learners even when they have under-qualified or poorly qualified teachers, as has been the situation in many Zimbabwean schools. Lawrence (2011) points out that, on the one hand textbooks provide support to new, inexperienced teachers or teachers who lack confidence to deliver lessons, and on the other hand they save the learners from the teachers' incompetence and deficiencies.

Concerning the value of textbooks to those teachers whose knowledge and experience of a subject is limited, Regis, Appova, Reys and Townsend (2006) say that most teachers at the elementary and middle school levels feel less confident teaching mathematics than the other subjects. Consequently, these teachers are more inclined to lean on the textbook for advice and direction. Sosniak and Stoldosky's (1993) study confirmed this point of view: they found that the same elementary teachers who felt free to add to textbook suggestions in reading and language stuck very rigidly to the tasks offered in mathematics textbooks, prompting Remillard and Bryans (2004, p.365) to label them as the "adherent and trusting" teachers. Furthermore, Jamieson-Proctor and Byrne (2008) argue that some teachers' heavy dependence on mathematics textbooks is caused by their low confidence and competence in teaching mathematics.

In related arguments several researchers have pointed out that textbooks are also important because they create opportunities for the teachers to learn, as a result of the new experiences and insights presented to them in the process of using these new textbooks (Remillard & Bryans, 2004; Davis & Krajcik, 2005; Leikin, 2006). The National Education Evaluation Development Unit (NEEDU) of South Africa identified opportunities for teacher learning through the Annual National Assessment (ANA) tests. NEEDU contends that teachers who administer the ANA tests and mark the learners' answers are exposed to good testing practice and appropriate standards. These teachers, therefore "can also see, first hand, the strengths and weaknesses of their learners, and hence come to understand the efficacy of their own teaching" (Department of Basic Education, 2013c, p.24).

The same effect can be expected from the teachers' use of mathematics textbooks: the learners' performance in mathematics could help the teachers to identify areas where they need to improve.

Christie, Butler and Potterton (2007, p.131) observed that “although resources do not teach – and there is much evidence of under-used resources in some schools”, schools that want to achieve good results may be seriously let down by resource constraints, such as the shortage of textbooks. Reys et al. (2004, p.61) describe textbooks as “a staple in USA schools”, meaning they occupy a dominant part in teaching and learning. Mohammad and Kumari (2007, p.1) cited Ian Westbury (in Oakes & Saunders, 2004) who described textbooks as the ‘heart of the school’. This phenomenon is not only true of the USA as international studies (Robitaille & Travers, 1992) have shown that “teachers of mathematics in all countries rely heavily on textbooks in their day-to-day teaching, and this is perhaps more characteristic of the teaching of mathematics than of any other subject in the curriculum” (Reys, et al., 2004, p.62).

Furthermore, Van de Walle (2007) pointed out that mathematics textbooks set good tasks for each lesson, plus they contain evaluation exercises to help the teachers gauge their learners’ computational and conceptual skills. Ornstein and Hunkins (2004) brought the dominance of textbooks to the fore in reporting that approximately 75% of the students’ total classroom time is spent engaging with textbooks. As a result it appears that what learners know is to a large extent a reflection of their textbook content.

The importance of textbooks has also been highlighted by Son (2009, p.947) who observed that “textbooks are concrete, and provide the daily information of lessons and units: what teachers and students do.” In support of this view, Lemmer, Edwards and Rapule (2008), and Reys et al. (2004) stated that textbooks provide a framework for what is taught, how it should be taught and in what sequence, and indicated that the textbook is one of the most critical factors which promotes or impairs learning.

However, there is also the downside to using textbooks. Lawrence (2011) cited several research studies whose findings identified potential disadvantages regarding the use of textbooks (Allwright, 1981; Harwood, 2005; Swales, 1995; Tomlinson, 2008; Ur, 1996). One disadvantage is that teachers are likely to become too reliant on the mathematics textbook, to the extent that their teaching will be devoid of any creativity. In addition, teachers may be tempted not to prepare for their lessons, thinking that the activities and tasks in the textbooks are superior to

their own ideas (Tomlinson). It is important for teachers to bear in mind that a textbook can never take the place of the teacher, no matter how good the textbook is.

2.3 THEORIES AND MODELS RELATED TO THE USE OF MATHEMATICS TEXTBOOKS

The researcher assumed an eclectic position to this study, and borrowed ideas from the theories and models discussed in this section. The research instruments and the analyses of the data were informed by these models, and by the findings from international studies on the teachers' use of mathematics textbooks. This choice helped to capture those aspects which would otherwise have been omitted through the use of only one theory or model.

2.3.1 Social constructivism

This study on grade 7 teachers' use of mathematics textbooks was largely guided by ideas from the field of social constructivism. Social constructivism emphasises the importance of culture and context in our understanding of what occurs in society and in the construction of knowledge. Shuford, Howard and Facundo (2006) highlighted three important assumptions of social constructivism. The first assumption states that reality is constructed through human activity. In other words, the members of a society together invent the properties of the world. The second assumption is that knowledge is a human product, and is socially and culturally constructed. In other words, individuals create meaning through their interactions with one another, and with the artefacts in their environment. In this regard Rezat (2006) observed that the textbook is an example of a cultural artefact that teachers use in a classroom situation. The third assumption is that learning is a social process, and that meaningful learning takes place when individuals are engaged in social activities.

In this study it was important to describe these social activities in the context of using the *Step in New Primary Mathematics Grade 7* textbooks in teaching and learning.

Social constructivism is explained below in two parts, namely the socio-cultural and constructivist perspectives.

2.3.1.1 The socio-cultural perspective

Haggarty and Pepin (2004) view textbooks as important in that they reflect the cultural values of a society. This notion of textbooks reflecting a society's cultural values is related to the socio-cultural theory of learning. The theory was first developed by Vygotsky (1978), whose major argument was that human cognition and learning are more social and cultural than individual phenomena. Individuals formulate socio-cultural meanings from the activities and actions of others, using signs or symbols and tools. Mathematics can thus be viewed as being situated in a socio-cultural context, and uses signs, symbols and tools- a mathematical language - and textbooks that have a peculiar meaning. Vygotsky claimed that social interaction is a key component in the development of knowledge. In a classroom setting this social interaction occurs between learners and teachers, with other learners, with textbooks and with other curriculum materials.

Furthermore, Vygotsky (1978) indicated that the ideas discussed in these social settings are external to each individual learner, and can be internalised or added to what the individual already knows. This 'transfer' from the external to the personal can only occur in each learner's zone of proximal development (ZPD). Van de Walle (2007, p.29) cited Goos (2004) who described the *zone of proximal development* as "not a physical space, but a symbolic space created through the interaction of learners with more knowledgeable others and the culture that precedes them". The *zone of proximal development* has also been described by Vygotsky as "the distance between what one can achieve alone and what one can achieve with help" (Peer & McClendon, 2002, p.137). In other words, the learner exists at a particular level of development but can be 'pulled' to a higher level of achievement as a result of instruction, help from effective teaching, or from engagement with more capable peers.

The importance of the theory is that it discriminates between the child's actual and potential levels of development. However, Turuk (2008) pointed out that Vygotsky's theory presents problems in terms of its application, and cited Shayer (2002, p.250) who expressed concern that

“Vygotsky did not offer much practical advice as to how the ZPD might be successfully applied in classrooms, and left it to others to find effective ways of doing so.”

Susuwele-Banda (2005) compared the ZPD to Piaget’s stages of intellectual development, which are viewed as critical to the teaching of mathematics because they suggest that the students’ readiness to learn is key to the learning of new concepts. The idea of *readiness* means that effective teaching takes into account the stage of development of a pupil, a view which Bruner (1966) referred to as a *half-truth*. Bruner’s (1966) argument was that if readiness is interpreted in a passive way as meaning that teachers should simply wait until children are ready to learn, “they may wait for a very long time, and may miss important opportunities for encouraging growth and development” (Lawton, 1982, p.53). It would appear that Bruner’s view is supportive of Vygotsky’s (1978) proposition of a ‘pulling’ of learners to a higher level, which occurs in the zone of proximal development. This help mostly comes from the mathematics teacher as he/she selects, explains and modifies the tasks in the textbook, and is called *scaffolding* (the connection-making process).

Vygotsky (1978) distinguished between scientific concepts, that is, those from the textbooks and the teachers, and so are external to the learner; and spontaneous concepts, representing those developed by the learner. The scientific and spontaneous concepts meet in the zone of proximal development of each learner, resulting in the learner adding on the new external ideas to those already developed in him. Therefore, learning can be promoted or impaired by the quality of social interactions that take place in the classroom set-up, and this includes the quality of tasks set in the textbooks, and how the teachers make use of them.

Remillard (2005) cited Brown (2002) who used the socio-cultural theory to explain the teacher’s interactions with the textbooks. Brown regarded textbooks as tools that have both a social and a cultural meaning; and as part of the material world, they are used to accomplish human goals. Thus textbooks - and this includes mathematics textbooks - are a means for transmitting socio-cultural norms and values that are contained in different national curriculum statements. In agreement with Brown’s view, Susuwele-Banda (2005) admitted that the knowledge and perceptions that individuals possess is the product of social factors and social tools.

Consequently, Rezat (2006) suggested that we should not only be interested in the culture of the classroom, but should also study the artefacts (that is, the textbooks) of the mathematics classes, and how they are used. From this viewpoint, a mathematics textbook can be regarded as a cultural tool: but whose culture? Textbooks as cultural tools have often been viewed as portraying the culture and interests of the dominant social group, what some post-modernists have described as the continuance of “the privilege of whiteness, to keep the ruling class in control of society” (Ornstein & Hunkins, 2004, p.189). For example, the mathematics textbooks are written in the English language which is a second language and a challenge to most indigenous or rural learners, especially those in African countries. In addition, most rural learners may be unfamiliar with the examples used in these textbooks.

- **Implications of the socio-cultural perspective for teaching**

Culture has an effect on how people live and learn. Every culture has a wide range of activities or practices that can be used to explain the mathematical concepts found in mathematics textbooks. Accordingly, Chikodzi and Nyota (2010, p.12) pointed out that “the unity between mathematics and culture is limitless, and so a culture-sensitive approach to the teaching of mathematics is advocated.” This ‘ethno-mathematics’ or culturally relevant pedagogy helps to make the subject meaningful and interesting by relating it to the everyday experiences of the learners.

The expert teacher is seen as central to the Vygotskian theory. Zevenbergen, Dole and Wright (2004, p.25) pointed out that it is the teacher’s role to “identify the student’s current mode of representation and then, through the use of good discourse, questioning or learning situations, promote the student to move forward in his or her thinking.”

- **The teachers’ role in using textbooks to promote the mathematical language of the learners**

Mathematics textbooks employ a language which incorporates ‘special’ terms and symbols to which some meanings have been socially subscribed. For learners to make sense of mathematical

ideas and to solve any given tasks they need to understand the language used in the classroom and in the textbook. In their study of American schools, Obara and Sloan (2009) found that language issues were a barrier to rich mathematical understanding. According to Turuk (2008), language is an important socio-cultural tool which helps the learners to understand mathematical concepts. An important task for the teacher is to foster the use, as well as the understanding of appropriate mathematical terms and expressions (Antony & Walshaw, 2009). Learners can be assisted in grasping the meanings of terms used in the mathematics textbook through the use of words and symbols with the same mathematical meaning, for example 'x'; 'times'; 'multiply'; or that 'doubling 6' is an alternative to '6 add 6'. Learners can also be encouraged to explain their methods of solving given problems, and offer reasons for their choices. To this end Runesson (2005) proposed that conventional mathematics language should be modelled and used so that, over time, it can 'migrate' from the teacher and from the textbook to the learners.

At the same time Carr (2006, p.5) presented three important steps that will help to develop the mathematical language of learners. The steps are:

1. The learners should be encouraged to develop the ability to listen, to question, to discuss, as well as to read information in their textbooks. Discussion can be done in pairs, in small groups, or by the entire class.
2. The teacher should explain the mathematical language used in the textbook when necessary, in order to enable the learners to build an appropriate mathematical vocabulary.
3. The concepts need to be adequately developed orally before the learners record them in writing, using correct symbols and mathematical expressions.

However, since the mathematics textbooks are written in English, a second language to the majority of the Zimbabwean primary school learners, the mathematics teachers frequently engage in language switching. This involves the teacher substituting a home or local language term for a mathematical term in order to help the learners to understand a concept. *Language switching* has been shown to enhance the learners' understanding, especially when the teachers are able to use it to capture the specific nuances of the mathematical language (Setati & Adler, 2001, as cited in Antony & Walshaw, 2009). A word of caution for teachers is not to over-do it,

to the extent that most of the mathematics lessons are taught in the home language (where such language is not English)!

2.3.1.2 The constructivist perspective

Piaget and Bruner are credited as two of the founders of the constructivist theory (Paulsen, 2008). The major tenets of the constructivist theory are that learners construct new ideas or concepts based on their existing knowledge, and that learning is an active process.

Piaget advanced constructivism through his cognitive theory. He argued that learners engage in reflective thought, which leads to the creation of connections or schemas between existing ideas and new ideas. Unlike Vygotsky's zone of proximal development, Piaget thought that it was the twin processes of assimilation and accommodation that resulted in the new learning or understanding of concepts. Paulsen (2008, p.39) described *assimilation* as the use of existing schemata or patterns to give meaning to new experiences; and *accommodation* as the alteration of existing ways of seeing things which results in changes to existing schemata.

The constructivist theory emphasises the importance of the knowledge and skills which learners bring to the experience of learning, so that the construction of a new understanding becomes a combination of prior learning and the new information. In seeking a satisfactory and expanded definition of *curriculum*, Johansson (2006, p.15) drew on John Dewey's argument, namely

Abandon the notion of subject matter as something fixed and ready-made in itself, outside the child's experience; cease thinking of the child's experience as also something hard and fast; see it as something fluent, embryonic, vital; and we realise that the child and the curriculum are simply two limits which define a single process (Dewey, 1956, p.189).

This definition of *curriculum* is consonant with the constructivist views expressed above.

Van de Walle (2007, p.71) suggested a constructivist approach to using mathematics textbooks, and reminded teachers that their task was to help learners construct relationships and ideas, not

to get them to ‘do pages’, and that the textbook should be viewed as one of a variety of teaching resources available in the classroom. Commenting on constructivism, Haggarty and Pepin (2004, p.5) cautioned that mathematics should be viewed as social in its origins and applications, not as a ‘given’ abstract body of knowledge that exists ‘out there’.

Closely related to this, Nickson (2001) pronounced that children are makers, and not receivers of knowledge, because they actively engage in selecting and adjusting what they experience in the world around them. The learners should therefore be placed in contexts where they can *experience* mathematics, so that the mathematics they meet at school can link with what they have already experienced in their natural or social environments. In this regard Zevenbergen et al. (2004) reminded us that learning is a social process, and that the learners construct more refined mathematical knowledge through dialogue and interaction. In order to promote this construction of knowledge, the learners should be engaged in the physical and social aspects of mathematics. Teachers of mathematics should bear in mind that the learners are not blank slates, or empty buckets that have to be filled. They use reflective thinking to modify their existing cognitive schemata to incorporate new knowledge and ideas.

In the same way Susuwele-Banda (2005, p.16) concedes that nowadays “most educators believe that knowledge is not and cannot be placed inside learners’ heads; rather learners construct their own knowledge by selectively using experiences around them”. In addition, the learners are not passive receivers of knowledge, but active participants, who construct knowledge for themselves. Therefore, it follows that the teachers’ role when using the textbook should be to:

- Guide and interact with the learners, by fully engaging them in all discussions.
- Focus on the learners’ thought processes, rather than solely on their ability to write correct answers.
- Establish a learning environment that sparks children’s interest in mathematics.
- Foster the learners’ autonomy in terms of the search for information and how they interact with textbooks and other learning materials. (Carr, 2006; Susuwele-Banda, 2005).

The Department of Basic Education (2013b, p.14) adds:

What is required are learner-centred approaches to enable them (learners) to work on their own with little support from the teachers. In order to enable the learners to participate in the instructional process, there is an imperative need to adopt some kind of learner-centred approaches in the classroom.

It was therefore important to ascertain the extent to which teachers in the Mashonaland East Province of Zimbabwe use the mathematics textbooks in the fulfilment of these roles.

Van de Walle (2007, p.71) pronounced that the textbook provides a source of ideas for designing lessons, rather than prescriptions for what each lesson will be. This perspective expects the pace of lessons through a unit to be determined by the learner's performance rather than by the artificial norm of two pages per day, and reminds teachers that there is no law saying every page must be done, or every exercise completed.

Furthermore, Perso (2006) conceded that the learners should be allowed to take risks and learn from their mistakes, as a way of building their confidence in using their mathematics knowledge and skills in contexts outside the classroom. In other words, the learners should be encouraged to develop their own mathematical strategies for solving problems (Carr, 2006). Thus inquiry and discovery as methods of teaching mathematics are to be encouraged. This constructivist stance from Perso implies that teachers should promote higher-order thinking and inquiry-based or problem-solving learning. It follows that the teachers have to correctly interpret the curriculum's intentions.

In this regard, Remillard (2005, p.220) cited case studies by Stake and Easley (1978) which focused on the state of mathematics and science education. There are two major findings from these case studies that are relevant when thinking about constructivism: First, not a single instance of mathematics or science was being taught through inquiry, which was the intention of the curriculum developers. Second, the teachers who were investigated seemed intent on 'covering the textbook' by marching the students rapidly through, and by presenting the subject matter as facts that experts found to be true.

The constructivist perspective cautions that the textbooks should not be followed religiously and without question. The teachers who took such a closed perspective ran the risk of accepting the content of the textbook as error-free and authoritative. Mathematics teachers are expected to use their discretion, guided by their knowledge, beliefs and experience in the learning area.

The critics of constructivism, for example Mayer (2004) and Kirschner, Sweller and Clark (2006) argued that such ‘discovery-based teaching techniques’ are not necessarily the ideal, especially for young learners who would benefit from first studying worked out examples that are presented in their textbooks, particularly in mathematics. After all, Carr (2006) conceded that although constructivist teaching should be emphasised, there was still room for didactic teaching at primary school level. Thus the ideal approach should be a mix of discovery-based teaching and the teacher’s explanation and demonstration on the procedure for doing the solutions to the textbook tasks.

The education policy in Zimbabwe promotes learner-centred, socio-cultural and constructivist approaches at all levels of schooling. In support of this notion, Mutemeri and Mugweni (2005) stated that from a social constructivist viewpoint such as Vygotsky’s, young children learn school mathematics more easily if it is meaningful in their lives and their cultures, if it emerges from their experiences, and forms part of their social lives. Even the aims of primary school mathematics education in Zimbabwe are consistent with both socio-culturalism and constructivism, as outlined in aims 3 and 4 in the grade 7 mathematics syllabus. Aim 3 seeks “to help pupils to acquire mathematical concepts and skills for use as tools in work, study, leisure and everyday transactions”. Aim 4 seeks “to develop sound mathematical skills that will enable them (learners) to interact more meaningfully and rewardingly with their environment” (Logan & Tambara, 2010a, p.176-177). These two aims are more likely to be achieved through the active involvement of learners in solving problems in their environment than through chalk-and-talk.

It was the purpose of this study to ascertain whether the teachers in the Mashonaland East Province of Zimbabwe were mindful of these ideas in their use of mathematics textbooks.

- **The implications of the constructivist theory for the teaching of mathematics**

Paulsen (2008, p.39) summarised the implications of constructivism by suggesting that meaningful learning is likely to occur when the teachers

- use activities which build on the learners' prior experiences, namely on what they already know;
- use activities which learners find interesting;
- provide immediate feedback to the learners, not only on the correct answers, but also on the process of arriving at those answers;
- use and develop the correct mathematical language;
- encourage the learners to work together and to make decisions; and
- are more learner-centred in their teaching.

In other words, the teachers should be able to plan to teach mathematics effectively, and for this to happen they need to have a good understanding of how the students learn mathematics.

One of the research questions in this study sought to find out the extent to which suggestions such as these are implemented by the grade 7 teachers in their use of the mathematics textbooks.

In the next section a number of models that were useful for investigating the teachers' mathematics textbooks use are described.

2.3.2 Rezat's (2006) Model

Rezat (2006, p.409) observed that while textbooks and the comprehension of mathematical text have received some attention in research on mathematics education, several authors point to a dearth of research into the use of mathematics textbooks. This Rezat attributed to a number of reasons, for example "the difficulty of obtaining data on how textbooks are used, and the lack of a theoretical framework for textbook use". Rezat further suggested an appropriate theoretical framework that could be a prerequisite for data collection on the use of textbooks. He initially

presented a triangular activity theory model for textbook use to help explain the teacher-textbook-learner relationship, but later developed it into a tetrahedron model of textbook use (Rezat, 2009). In the triangular model the three vertices represent the teacher, the learner and the textbook, while the fourth vertice in the tetrahedron represents mathematical knowledge, as depicted in Figure 2.1.

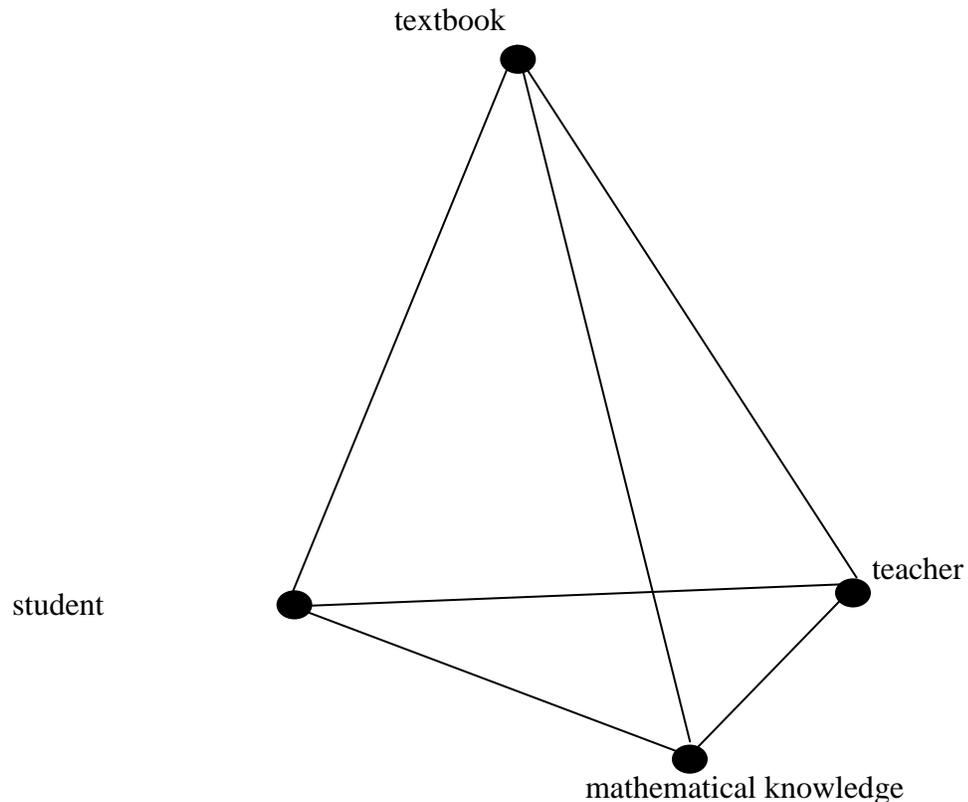


Figure 2.1: Rezat's tetrahedron model of textbook use
(Rezat, 2009, p.1261)

The three-dimensional tetrahedron model attempts to explain how textbooks are used in the classroom, with each of the triangular faces or vertices representing a different aspect or activity system of the use of the textbook as follows:

- The student-teacher-textbook. The teacher makes use of the textbook in class. For example, the teacher gives tasks or demonstrates how to solve problems presented in the textbook.
- The student-textbook-mathematical knowledge. The student uses the textbook on his own

initiative, without the teacher's help.

- The teacher-textbook-mathematical knowledge. The teacher uses the textbook to decide on instructional methods, like teacher exposition or group work.
- The student-teacher-mathematical knowledge (Rezat, 2006, p.414). The teacher does not explicitly use the textbook during the lesson, but makes reference to knowledge or information that is contained in the textbook. An example is when the teacher formulates his own problems that are similar to those found in the textbook, and asks the learners to solve them.

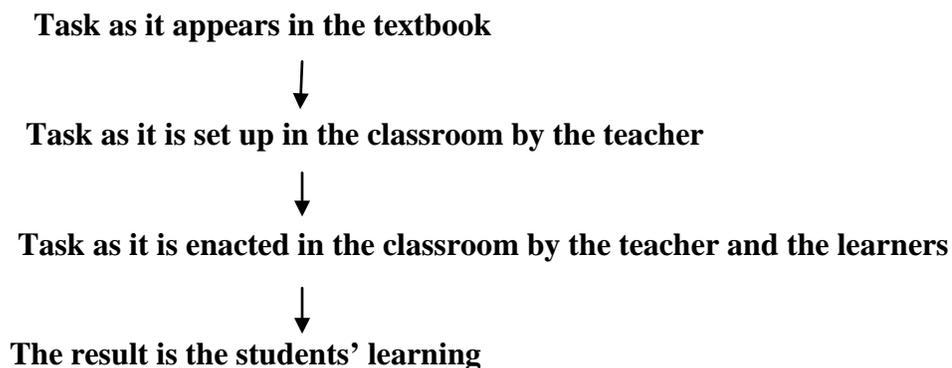
Rezat argued that the fourth activity (student-teacher-mathematical knowledge) has been substantiated in several studies on textbook use (e.g., studies by Stodolsky, 1989; Valverde et al., 2002; Wood & Elliott, 1990). This model can be used to explain not only how the teachers but also the learners use the textbook. Rezat himself did not conduct any study using this model, but suggested how one could use it to collect data. The methods that can be used to investigate the use of the textbook that arise from the activity theory demand that researchers use three criteria (Rezat, 2006). First, the actual use of the mathematics textbook should be recorded in detail. Second, biases caused by the researcher or by the situation should be minimized. Third, the use of the textbook should be recorded at any time and any place it is used (Rezat, 2009, p.1262).

These criteria for investigating the use of the textbook helped the researcher to formulate appropriate questions for the lesson observations and interviews. The lesson observation instrument that the researcher used (see Appendix D) has sections for recording what the textbook was used for in each lesson, the section or page number used, and when it was used (for example, in introducing a task, a worked out example, individual or group work). The interviews gave the teachers the opportunity to explain how they used the textbook.

The term *mediation* was used by Rezat (2006) to describe the ways in which the teachers interpret, restructure, simplify, organise and use the content in the textbook. The major 'actors' in the use of the textbook are the teacher, the learner and the textbook. The use of a textbook is an activity that provides knowledge within a cultural context. As an instrument for teaching and learning the textbook addresses both the teacher and the learner.

2.3.3 Stein and Kaufman's (2010) Model

Stein and Kaufman (2010) developed a framework which explains the phases of task implementation, and the factors that shape it. This model helped to shed some light on how the teachers use or should use the mathematics textbooks in teaching and learning. The model shows a linear development in the implementation of a textbook task. In this model the task is first represented in the textbook (curricular materials), then it is restructured or mediated by the teacher, and finally implemented by both the teacher and the learners in the classroom environment. The end result is student learning. Simply stated, Stein and Kaufman's phases of textbook task implementation can be represented as shown below



The model is important because it pays attention to the tasks in a textbook and how the teacher uses them. Interestingly, research by Stein, Grover and Henningsen (1996), and Stigler and Hiebert (2004), (as cited in Stein & Kaufman, 2010) revealed that the features of an instructional task, especially its cognitive demands, change as the task passes through these phases. Consequently, tasks can be labelled as high-level or low-level, or as high-quality or low-quality, as described below, in their study of teachers in two New York districts.

Stein and Kaufman (2010, p.671) used this model in a study of two New York districts on teachers across the span of elementary grade levels, and focused on the quality of implementation, the teachers' capacity and the teachers' use of the mathematics textbook. By *teacher capacity* Stein and Kaufman meant "the teachers' education, experience, knowledge of mathematics for teaching, and mathematics professional development hours per year." These are

some of the factors that influence how teachers make use of the mathematics textbooks.

One of the findings from this study was that the teachers used the textbook tasks in such a way that they can be categorised as high-quality or low-quality tasks. Teachers employing high-quality tasks pay particular attention to what the learners do and say, so as to understand their mathematical thinking. The teachers also take into account what the learners bring to the learning situation. This is accompanied by the teachers moving around the classroom while the students work on textbook-based tasks, followed by whole class discussion sessions. In addition, the learners are 'authorised' to solve problems by themselves, as long as they can justify their strategies or mathematical reasoning. These practices are consistent with the social constructivist philosophy, which the Zimbabwean grade 7 syllabus advocates (Logan & Tambara, 2010b).

In contrast, low-quality tasks involve the learners in routine procedures and memorisation without connections, and the tasks are characterised by the teachers "frequently showing learners how to find the answers in an algorithmic instead of letting them problem-solve" (Stein & Kaufman, 2010, p.670). This approach ignores the fact that the learners should be guided in solving the problems and in creating their own patterns or strategies for doing so.

Another important observation emanating from this study by Stein and Kaufman (2010) is that most mathematics textbooks present their content in the spiral curriculum format. The spiral curriculum is a brainchild of Bruner (1966). This format presents one big concept at varying levels of difficulty and in various ways over and over again as the learner progresses through the year and through the grades. This arrangement presents challenges for some teachers when using the textbook, since they may find it hard to discern the bigger picture, as each unit provides only partial coverage of a bigger topic.

2.3.4 Lee's (2011) Model

In her study of the use of mathematics textbooks by elementary school teachers in Korea, Lee (2011, p.12) developed a checklist of six aspects, summarised below.

- The extent of the use of the mathematics textbooks and the reasons why some teachers do not use them. The frequency of making use of the tasks in the textbooks was also explored
- Time of use, for example before the lesson (planning), in the middle of a lesson (in lesson time) or after the lesson (as in giving homework).
- Methods of use, described as ways of using the textbook, and ways of teaching and learning when using the textbook, for example in doing individual work, small group or whole class discussion.
- Restructuring the textbook, namely whether the teachers re-order the topics in the textbook or not, and the reasons why they reconstruct the textbook.
- The use of assisting materials, that is, whether or not they use the textbook together with other resources, the types of supplementary materials used, and the reasons for using these assisting materials.
- What the teachers mean by the effective use of mathematics textbooks, and their ideas on effective textbook use.

Lee (2011) used this checklist in a study of elementary mathematics teachers in Korea, which focused on the ways of using the textbook, and the ways of teaching and learning effectively when using the textbook. Most teachers reported using the textbook in lesson preparation, and in the opening and expanding stages of the lesson. More than 52% of the respondents indicated that they taught all the content of the textbook. On the ways of teaching using the textbook, 74% of the teachers used the explanation method, while discovery learning and collaborative learning or group work were used to a lesser extent.

The findings from this study confirm that the teachers predominantly rely on traditional teaching methods, where the teacher is viewed as the source of all knowledge. This position is

inconsistent with the constructivist thought, namely that the teachers should promote active learning, and learner-centred environments. Accordingly, Lee (2011, p.3) made the important observation that “if the textbook is a necessary resource for teaching activities in the classroom, we should make good textbooks first and guide teachers not to simply follow the given textbook but to use them effectively.” This is, in fact, a call for thorough teacher preparation, either pre-service or in-service, as well as ensuring a high quality of mathematics textbooks.

Respondents in Lee’s (2011) study were asked to give their opinions on what they felt were effective ways of using the mathematics textbooks. Their responses were then ranked. Highest in rank-order was the response that the teachers have to centre their teaching on the textbook, but that the teacher needs to reconstruct the textbook. *Reconstruct* in this sense meant the same as to restructure or re-sequence. Depending on the learners’ level of understanding and attention, both the order and content should be restructured, but the learners should learn all the content of the textbook. The second highest response was on the teachers using the mathematics textbook as a reference resource, without the need to teach all the textbook content. There was no general consensus among respondents in Lee’s study on what amounts to effective mathematics textbook use. This should not be surprising, given the varied factors that influence individual teachers’ use of mathematics textbooks, as discussed in section 2.6. These teachers, however, recommended the need for professional development programmes focused on the use of the textbook; and that textbooks should have activities and tasks that can be done by learners by themselves, as well as in collaborative groups.

This model was useful in the current study in that it helped in the construction of research instruments and in the formulation of research questions for use in answering questions on the use of the textbooks by teachers in Zimbabwe. For example, the lesson observation instrument included a checklist on the frequency of the use of the textbook, and how the textbook was used in each of those times. In addition, the teacher interview schedule asked for the reasons why the teachers used some resources to supplement the *Step in New Primary Mathematics Grade 7* textbook. The analysis of the lessons that were observed also made use of Lee’s (2011) model.

2.3.5 Johansson's (2006) Model

In order to describe the use of the textbook in detail Johansson (2006) developed two coverage codes, namely *textbook influence* and *classroom interaction*. These codes helped to show how much time in minutes a teacher devoted to each aspect in a mathematics lesson. Each of the two codes is divided into three classes, as described below.

Textbook influence.

- Textbook direct influence: The teacher makes explicit use of the textbook, the learners work individually or in groups on exercises from the textbook. The teacher makes explicit comments about a text, a problem, or a picture in the textbook, or reads directly from the textbook.
- Textbook indirect influence: The teacher makes verbal or written statements that are parallel or comparable to those in the textbook without referring to it. For example, the teacher shows a completed example on the board that is similar to one in the textbook.
- Textbook absence: The teacher makes connections to other mathematical areas or to everyday life applications which are not in the textbook.

Classroom interaction.

- Public interaction: The teacher stands in front of the class, writes on the board, presents problems, poses questions from the textbook, verifies or disproves answers.
- Private interaction: The learners engage in practice, mainly individually with tasks in the textbook. The teacher walks around the classroom, observes and interacts with the learners.
- Mixed interaction: These are occasions when a learner stands in front of the class, writing or working out a solution to a textbook problem on the board, with or without the involvement of the other learners (Johansson, 2006, p.9).

However, there were instances when there was a combination of mixed and public interaction, when the learner wrote on the chalkboard, but then the teacher interrogated him/her, as well as the rest of the class on the work displayed on the chalkboard.

There are two important points worth noting about this model. Firstly, it is possible that pair work and small group work, based on the textbook exercises, form part of the private interaction.

Secondly, there are instances within a lesson which may not be very easy to classify neatly into the suggested categories. However, this model is useful in analysing the ways grade 7 teachers used mathematics textbooks in the lesson observations (see section 4.3.1).

2.4 INTERNATIONAL STUDIES ON THE TEACHERS' USE OF MATHEMATICS TEXTBOOKS

▪ Teachers' patterns of textbook use in Australia

Jamieson-Proctor and Byrne (2008) conducted an investigation regarding primary teachers' beliefs about the use of mathematics textbooks and factors that influenced their decisions to use them in mathematics lessons. The study was also aimed at ascertaining the frequency and pattern of use of student textbooks by these teachers. The investigation was done in Queensland, Australia, and involved 34 teachers. A teacher survey was developed and administered on 34 teachers in two urban primary schools. Teachers from pre-school to year 7 were the respondents. The Statistical Package for the Social Sciences (SPSS15) was used for the analysis of the data.

Findings from this study indicated that these teachers 'are not as reliant on textbooks as is reported in the literature' (Jamieson-Proctor & Byrne, 2008, p.298). In addition, the ways the teachers in these two schools used textbooks were found to be inconsistent with findings from previous research, in that they were more flexible and 'changeable' in their use of textbooks. For example, whereas the literature suggests that a teacher's instruction often matches the sequence laid out in the textbooks (Johansson, 2005), over 55% of the surveyed teachers reported 'Never' following the textbooks' sequence of lessons. These teachers' decisions to use or not to use mathematics textbooks were influenced by other factors, such as their perceptions of the educational value of the textbooks, and the teachers' confidence and competence in mathematics teaching. These results can be explained because the study involved only two schools, both urban, and it cut across grades from pre-school to the 7th school year. Thus, all these teachers

would not have been using the same textbook.

- **Textbook use in classrooms in Germany, England and France**

Haggarty and Pepin (2004) reported on the results of studies on the teachers' use of mathematics textbooks in schools in Germany, England and France. The data collected enabled three generalisations to be made across the cases studied in the three countries:

- The teachers spent less time on the explanation and development of mathematical concepts and more on the teaching of algorithms, followed by the learners' written exercises.
- A lack of time, particularly in English schools, was often cited as inhibiting the teachers' lesson planning. As a result these teachers relied more on the textbook, especially when they were less experienced.
- A lack of time in some cases resulted from too many responsibilities being given to some teachers in the school, like being in charge of sports and the school choir, and was the excuse given by many teachers for their failure to plan their lessons.

Therefore, these teachers were followers of the textbook who focused more on teaching the procedures rather than on conceptual understanding.

- **Textbook use in Namibian classrooms**

Lubben et al. (2003) conducted a study which sought to identify the different forms of references made by the teachers to the textbook. Three data collection sources were used. These were tape-recordings of classroom exchanges, non-participant observation, and copies of the sections of the prescribed textbooks used during the lessons. One of the findings from their study of the teachers' use of textbooks in Namibian science classrooms was that in one quarter of the observed lessons the textbook was not referred to at all, and 15% of the references to the textbook were related to homework. The textbook was referred to for use by either the whole class, a group in the class, or an individual, and for use at school or at home.

Another finding from the study was that the presence of prescribed textbooks was not a guarantee that they would be used effectively, or used at all. This led to the suggestion that the teachers' staff development programmes should incorporate a module on the effective use of mathematics and science textbooks, and a new focus on the changing role of the teacher in the teaching and learning process: that is, the teacher is not the only source of knowledge, and that he or she should facilitate the learners' process of learning (Susuwele-Banda, 2005)

The value of this study is that the Namibian environment is relatively similar to that of Zimbabwe, as both are developing African countries, and the teacher practices are not likely to differ much. Of importance is the finding that the availability of textbooks does not always mean that the teachers and the learners would use them.

However, this study did not describe exactly what the textbook was used for, or how the teachers used the textbooks in their actual teaching, that is, when references were made to the textbook in lessons, what actually was referred to in the textbook? It is also important to know this in relation not only to science but also to mathematics teaching. To this end Lubben et al. (2003, p.123) recommended as follows, "Further research needs to identify why textbooks are used in the way they are, and, where this is inappropriate, how best to educate teachers to use textbooks more effectively."

- **Mathematics textbook use in American classrooms**

Chavez-Lopez (2003) used ideas from a model proposed by Remillard and Bryans (2004, p.3-4) to study the teachers' use of the textbook in American middle school classrooms. This was a two-year long sponsored study, a project of the University of Missouri-Columbia. Surveys, textbook diaries, classroom observations and case studies were used to gather data from 53 teachers in 11 middle schools. The classroom observations were free-text descriptions of how teachers used the textbooks. The study was premised on the view that more still needs to be learned "about how mathematics textbooks are used", and that textbooks "determine the range of possible activities for the classroom, thus influencing greatly what teachers are likely to do, even if they do not restrict what teachers can do" (Chavez-Lopez, 2003, p.4).

The findings from this study were that the majority of the teachers (59%) used textbooks frequently, to select tasks and to plan their lessons. Thirty eight percent of the teachers agreed that textbooks are important in teaching, but that they relied more on their previous instructional experiences, knowledge, and other supplemental resources (Regis et al., 2006). Also, those teachers who had been part of the textbook selection and adoption process had a more positive attitude toward the textbook, and implemented the textbook faithfully and committedly.

The researcher adapted the questionnaire and lesson observation tools from those used in Chavez-Lopez's (2003) study (see section 3.3.3), because it was believed that, having already been used successfully, they would enhance the quality of the data gathered in this study.

- **The extent of the teachers' adherence to the content of the mathematics textbook**

The teachers in a study by Nicol and Crespo (2006) followed the mathematics textbook page by page and step by step, having accepted the textbook as the absolute authority for what and how to teach. Minimal changes were made to the contents of the mathematics textbook. The teachers' teaching followed the routine of asking the learners to produce their textbooks, leading them through the day's lesson, doing some examples, and then asking the learners to complete the rest of the questions in the exercise as homework. Unfortunately, this approach may result in the superficial coverage of many of the concepts.

Ying and Young (2007, p.155) observed that many teachers tended to perceive an authority invested in textbooks "which in turn functions to reduce their cognisance of the potential of textbooks to support and encourage their creativity." If teacher training and professional development programmes do not encourage the development of textbook interpretive skills, the teachers risk becoming mere technicians in the teaching and learning process.

Ying and Young (2007) cited Hall (2004) who further cautioned that textbooks have the potential to both control and deskill the teachers' professional knowledge.

In their study of two teachers' enacting mathematics lessons, Lo, Kim and McCrory (2008) analysed what content the teachers skipped or added in the textbooks in use when teaching fractions, and why they did so. They found that both teachers skipped approximately the same number of textbook ideas, examples and exercises. For example, among those skipped was a discussion on the rule for fraction division equivalence ($\frac{a}{b} = a \div b$) which would enable the learners to understand that 17 divided by 4 has four answers (that is 4 remainder 1, $17/4$, 4.25, $4\frac{1}{4}$), depending on the context of the question. At the same time the teachers added examples during their lessons, some of them more complex than those given in the textbook. One of the teachers added two questions, 'solving $\frac{1}{2} + \frac{1}{3}$ and $\frac{1}{2} \times \frac{1}{3}$ in order to make clear the difference between fraction addition and multiplication' (Lo, Kim & McCrory, 2008, p.6).

Similarly, Chavez-Lopez (2003, in Regis et al., 2006, p.11) noted that, "Even teachers who typically use their textbooks do so in very different ways." Some teachers followed the textbook almost page by page; others skipped or added content from a variety of sources, and others did not use the textbook at all. Instead they created their own instructional materials based on their experience of teaching mathematics and their beliefs on how mathematics should be taught. These findings helped to answer in part the research question concerning how differently teachers use the same textbook content. It is important to know how they did this in the Zimbabwean context, and to know the reasons why they did so.

More recently McNaught et al. (2010) conducted a study in the U.S. on *implementation fidelity*, a term they used to describe the extent of the teachers' adherence to the use of the textbook in classroom instruction. It has been argued that the level of implementation fidelity is useful in gauging the effectiveness of a textbook, and in making inferences on student achievement (Bowzer, 2008; McNaught et al., 2010; N.R.C., 2004). The study was premised on the realisation that the teachers used the same textbook content in a variety of ways. This was supported by research on textbook use which points to the fact that the implementation of the curriculum is an uneven process within and across schools (Kilpatrick, 2003; Senk & Thompson, 2003). Therefore McNaught et al.'s (2010) main focus was the extent and the ways in which teachers used textbooks in their day-to-day teaching. Their study was related to implementation differences of

two types of mathematics textbooks at secondary school level, and it addressed two aspects, namely content implementation fidelity and presentation implementation fidelity. In this case *content implementation fidelity* means how much of the textbook content is used “on a continuum from exactly using what is written in the textbook to the extreme of regularly skipping or substituting content” (McNaught et al., 2010, p.2). The research methods used were textbook-use diaries, table of contents records and classroom visit protocols. These methods helped to establish what textbook material was used in the lessons, and whether textbook lessons were taught as they were presented in the book, altered or omitted. In order to capture the nature and extent of textbook use three indices were developed, namely opportunity to learn, the extent of textbook implementation, and the textbook content taught.

Results from this study revealed that less than 75% of the content in the textbooks was covered, regardless of the type of textbook used. In addition and more importantly, McNaught et al. (2010, p.12) reported that “across the teachers studied 35% of the content was taught primarily from the textbook, 21% of the content was taught with some supplementation, 12% was taught from alternative resources and 32% of the content was not taught.”

The value of this study is not only that it provides a model for describing textbook implementation, but it also provides a measure of the extent to which textbooks are used in teaching mathematics content. The findings, especially that up to 32% of a mathematics textbook content was not taught, are important for the school administration, curriculum developers and policy-makers to make informed decisions concerning the curriculum.

Although McNaught et al.’s. (2010) study was in secondary schools and related to two different types of mathematics textbooks, it provides useful methodological issues, for example the classroom visit protocols enabled the researcher to see first-hand and record instances of textbook use by teachers during mathematics lessons. Some of these findings are consistent with those reported in studies of mathematics teachers’ use of textbooks in elementary and middle school grades (Chavez-Lopez, 2003; Jamieson-Proctor & Byrne, 2008; Son, 2009). It should therefore be productive to conduct more research of this nature, focusing on the use of a single mathematics textbook, and in a developing country.

- **How teachers in the same school differ in the patterns of their use of textbooks**

Son (2009) reported that most of the previous studies on the use of the textbook focused on the maximal extent of coverage, such as to what extent the teachers used textbooks in planning and teaching school subjects. These studies provided three different patterns on the use of the textbook, namely textbook follower, textbook adaptor and textbook ignorer. Bowzer (2008) describes a *textbook follower* as one who allows the textbook to control the mathematical activity during a class period.

In a study of two 4th grade teachers' use of mathematics textbooks, Son (2009) established that they used the same textbook differently. For example, one of them decreased the cognitive demands of the teacher's questions in ways that required lower levels of student thinking. This study of two 4th grade teachers used observation and teacher interviews on their teaching of a fraction unit over 2 semesters. The differences in how these two teachers used the same textbook were partly due to their different teaching goals, which "in turn provided different notions of knowing mathematics and doing mathematics" (Son, 2009, p.954). For example, one teacher wanted the learners to memorise and follow the rule in finding equivalent fractions. This procedural approach was interpreted as *traditional teaching*. The other teacher wanted the learners to develop the underlying ideas, generate the rule, and apply the rule to find equivalent fractions, an approach reflecting the teacher's cognisance of social constructivist thinking. Therefore, the teachers' ideas concerning how mathematics is learned contributed to the way they used the existing textbooks.

- **Comment**

The majority of these studies were conducted in developing countries. In some of these studies the participant teachers had been involved in the textbook selection process, while in others they were not.

It has been argued that there was sometimes no link between the availability of textbooks and

their actual use by the teachers and the learners; that the teachers may not use textbooks in their classrooms even when they are readily available (Jamieson-Proctor & Byrne, 2008); and that the teachers did not automatically change their teaching practices merely by being exposed to new or innovative materials; thus supporting the belief that the teachers needed training in order to implement the vision of reform materials, and to make them better users of mathematics textbooks.

None of the studies reported above appears to have been conducted in a rural environment, an anomaly that this study addressed. This is important because in developing countries like Zimbabwe, there is a large rural population. Few studies used a mixed methods research design, which this study adopted. More importantly, the results of the studies in other contexts and other countries cannot be the same as studies conducted in Zimbabwe. Therefore, what we learn about the grade 7 teachers' use of mathematics textbooks must come from research in Zimbabwean schools.

It should be noted that all these studies did not reveal how the teachers actually used the content in the mathematics textbooks at specified intervals in lesson progression, and why they did so, hence this study.

However, the teachers did make use of the textbooks, and the extent of the use appears to be determined by both individual teacher factors and contextual factors, as will be discussed in the next section of this chapter.

2.5 FACTORS THAT INFLUENCE THE TEACHERS' USE OF MATHEMATICS TEXTBOOKS

One of the research questions that are discussed in this study concerns the factors that influence the teachers' use of the mathematics textbooks as they do.

A number of studies have been done on the factors that influence the mathematics teachers' use

of the textbooks (e.g., by Carr, 2006; Jamieson-Proctor & Byrne, 2008; Moffett & Corcoran, 2011; Remillard & Bryans, 2004; Reys et al., 2004; Santos et al., 2006; Son, 2009; Stein & Kaufman, 2010; Stein, Remillard & Smith, 2007). Some of these factors have been mentioned in passing earlier in this chapter.

The factors discussed in this section are the teachers' knowledge of pedagogical content, their beliefs, their teaching experience, and their levels of confidence, pressure from the parents, educational policies, and school system factors.

- **The teachers' knowledge of pedagogical content**

In a comparative study on mathematics teachers in Chinese and U.S. middle schools the researchers An, Kulm and Wu (2004, p.146) focused on the teachers' knowledge of pedagogical content. They named three components of pedagogical content that the teachers should possess namely knowledge of the content, knowledge of the curriculum and knowledge of teaching. *Content knowledge* refers to the specific mathematics content at the grade level being taught. *Curriculum knowledge* is the extent to which the teachers understand the goals and key ideas contained in the textbook in use. Lastly, *knowledge of teaching* is concerned with the teachers' preparation for and their mastery of the methods of delivering instruction.

An et al. (2004) also highlight the importance of the teachers' understanding of the learners' thinking, including their cultural backgrounds. They referred (2004, p.146) to the Chinese proverb, namely if you want to give the students one cup of water, you (the teacher) should have one bucket of water of your own, meaning that a teacher should possess extensive and organised knowledge of content, curriculum, teaching methods and of how children learn.

In agreement with the need for knowledge of the subject matter Ogbonnaya (2011, p.25), citing Smith (2010), said, "Strong and useful pedagogical content knowledge cannot be built on a shaky content foundation." Furthermore, Antony and Walshaw (2009) argued that when teachers' knowledge is robust, they use it to make key decisions concerning mathematical tasks and classroom resources. In addition, they suggested that the development of pedagogical

content knowledge can be greatly enhanced by the efforts from the school community and the support provided by professional development initiatives.

How much the teachers know may result in two kinds of learning, namely learning as knowing or learning as understanding. The former (learning as knowing) tends to be disconnected and superficial, the result of memorisation; the latter results in subject mastery. Therefore, how the teachers use the mathematics textbooks is bound to be strongly influenced by their pedagogical content knowledge. In this regard Ornstein and Hunkins (2004, p.321) made the important comment that “teachers with their knowledge and competencies are and must continue to be central to any curriculum improvement effort.”

Although this study by An et al. (2004) compared Chinese and U.S. middle school teachers, it has value from an international perspective because it can promote our understanding of what effective mathematics teaching entails, and this has relevance in the context of this study, namely of how grade 7 teachers in Zimbabwe use mathematics textbooks.

A teacher’s pedagogical content knowledge is closely linked to the other teacher factors referred to by Stein and Kaufman (2010), as discussed in section 2.3.3.

- **The teachers’ beliefs**

The teachers’ beliefs concerning the subject matter have a great bearing on how they use the textbooks and what they learn from them. Concerning teacher beliefs, Collopy (2003) referred to earlier research findings by Nespor (1987) and Pajaras (1992) that suggested some of the teachers’ beliefs were formed through their own experiences as mathematics students, and that these beliefs tend to have a great influence on the teachers’ decisions on how they use the mathematics textbooks.

Ogbonnaya (2011) cites similar studies by Beswick (2008), De Leon Carillo (2007) and Rath (2001) that have documented how teachers’ beliefs about teaching and learning are influenced by the teachers’ training, professional development and experiences- both as students themselves

and as teachers. These beliefs can be categorised as beliefs about the nature of mathematics, the nature of the learners, the nature of mathematics teaching, and the process of learning mathematics.

In line with previous research findings, Jamieson-Proctor and Byrne (2008) characterised the teachers' beliefs as either traditionalist or constructivist. *Traditionalist* teachers tend to use the textbook and follow the methods and sequence given in the textbook without modification (Stipek, Givven, Salmon & MacGyvers, 2001); whereas *constructivist* teachers are more likely to modify the activities in the students' mathematics textbook, or not use the textbook at all (Kagan, 1992; Stipek et al., 2001).

- **Teaching experience**

Research findings suggest that generally the more experienced teachers tend to vary their use of the mathematics textbooks (Stein & Kaufman, 2010). Furthermore, teachers who underwent more comprehensive pre-service and in-service education and training programmes are more likely to be better equipped in textbook use, while the under-qualified and inexperienced teachers tend to lack confidence and will follow the textbook content with few, if any, adjustments to its sequence and content (Santos et al., 2006).

- **Teacher confidence**

In reporting the use of textbooks of two experienced primary school teachers, Collopy (2003) addressed the aspect of teacher confidence. The confident teacher with 'good' mathematics content knowledge used the new materials infrequently, and omitted some activities suggested in the textbooks, but supplemented it with the usual lessons on computation. The less confident and less knowledgeable teacher followed most of the work as outlined in the textbook, thinking it helped the learners' understanding of the concepts. The mathematics teachers in Collopy's (2003) and Remillard's (2000) studies used the textbooks selectively, and often omitted tasks and activities they thought were irrelevant. The teachers' expertise and confidence are therefore evident from the frequency with which they depart from strictly relying on the prescribed mathematics textbook.

In Jamieson-Proctor and Byrne's (2008) study more than 50% of the teachers had very strong beliefs about their levels of confidence and competence to teach mathematics. Previous studies suggested that teachers with high levels of self-efficacy about mathematics are more likely to modify or teach without textbooks. The teachers' mathematics content knowledge and their confidence are closely related factors. For instance, the Department of Basic Education (2013b) observed that insufficient mathematics content knowledge often leads to low confidence levels among teachers. This may be seen when the teachers fail to engage the learners in meaningful ways on the strategies that they have used.

- **Pressure from the parents**

Moffett and Corcoran (2011) indicated that the pressure to meet parental expectations affected the teachers' use of the textbooks. In fact, one view expressed in an Irish teacher survey was that the parents led the drive for textbook use, and that they felt that the completion of a mathematics textbook's content was a sign of good teaching (Carr, 2006).

The same view was expressed by Perso (2006, p.23), namely that "the teaching of mathematics has often resulted in a cover to cover approach, frequently insisted upon by parents wanting to get their money's worth from the textbooks." However, it is the quality of the coverage of the textbook content that constitutes good or bad teaching, and not the fact that the textbook has been covered from the first to the last page.

The grade 7 mathematics end of year examinations in Zimbabwe are used for learners to gain access to 'good' secondary schools, so the teachers are under pressure from both the parents and the school administration to cover the textbook content. This is especially so in poorly resourced schools where coverage of the only available mathematics textbook title is deemed as synonymous with syllabus coverage.

- **'School system' factors**

Pressure from the school administration may take the form of a heavy work load placed on the teachers, which encourages them to rely on the mathematics textbooks' pre-planned lessons. The

conditions under which the teachers work, for example the availability of teaching resources, the number of mathematics professional development hours per year, or the frequency of contacts the teacher makes with mathematics teachers in other schools to discuss/share professional matters, the time allocated on the timetable for the teaching of mathematics, and the disruptions to the school timetable are all important factors that will determine the quality of the mathematics textbook usage (Ogbonnaya, 2011). Constant disruptions to the school timetable affect the quality of the use of the mathematics textbook as the teachers may cover the content in a superficial way in an attempt to cover all the content.

It was important to ascertain whether or not the teachers in the Mashonaland East Province of Zimbabwe were also influenced by the factors discussed above, or by any other factors (such as the culture of the school) in their use of textbooks in the teaching of mathematics to grade 7 learners, and to what extent.

2.6 THE IMPACT OF NEW TEXTBOOKS ON THE TEACHING AND LEARNING OF MATHEMATICS

An important dimension in studying the teachers' textbook use is how the teachers change their teaching practices, and are themselves changed through the use of new textbooks. Several research studies have addressed the effect of using new textbooks on teaching and learning (Moffett & Corcoran, 2011; Nicol & Crespo, 2006; Remillard & Bryans, 2004).

Some of these study findings are discussed below.

- **Opportunity for teacher learning**

In the process of using a new mathematics textbook, some teachers learnt and modified their ideas about mathematics, about how it is taught and learned. The teachers' reflection on how the children engaged with mathematics improved, a boost in the teachers' confidence was reported, together with an increase in the teachers' use of real life contexts for teaching mathematics

(Moffett & Corcoran, 2011; Remillard & Bryans, 2004). These findings raised a number of important questions, for example: is the use of a new textbook necessarily a form of teacher learning and development? And do teachers often receive the necessary support in learning how to use these mathematics textbooks?

- **The textbook as a source of motivation and discipline**

Nicol and Crespo (2006) regarded the new mathematics textbook as providing motivation to teachers, learners and parents. In this regard Kwaramba (2012) noted that there had been an increase in school attendance of the learners at one primary school since the launch of the ETF, as each learner now had a full set of textbooks. Furthermore, Nicol and Crespo argued that the textbooks served as a tool for discipline, namely they keep the learners on task, and ‘force’ them to work harder when faced with the possibility of carrying the textbook home to finish their work.

- **Using textbooks in deciding what and how to teach**

In a study by Nicol and Crespo (2006), the teachers viewed the textbook as providing them with a structure on what to teach and how to teach, and as a relief, because they did not always have to create original lessons. Textbooks can also provide the teachers with security, as they may use them as the basis for planning (Perso, 2006). However, the material in the textbooks was used in two qualitatively different ways, namely, creating text, and adhering to the textbook (Nicol & Crespo, 2006; Ying & Young, 2007). Teachers’ adherence to the textbook was discussed earlier in this chapter. Teachers creating text is described below.

- **Creating and using text creatively**

The teachers in the study by Nicol and Crespo (2006) used the mathematics textbook as a source of ideas, and used it only as one of many resources for teaching mathematics. This approach was based on a critical view that focusing on a single mathematics textbook becomes boring and uninspiring to the learners. For example, a textbook picture of a person folding a flag to illustrate

the concept of line symmetry led the teacher to bring to the classroom a number of large flags for the learners to fold, and to discover for themselves what made or did not make a line of symmetry (Nicol & Crespo, 2006, p.346).

Again, the study by Nicol and Crespo (2006) was conducted with teachers in North American classrooms, so it was pertinent to establish what impact new mathematics textbooks have had on teaching and learning in the Zimbabwean context.

- **Textbooks and learner performance**

Whether textbooks actually help or hinder the teaching and learning process is an on-going debate. On the one hand, research from several countries has indicated some improvement in learner performance when sufficient textbooks were supplied. This, in part, is due to the fact that the learners can practise, and do the homework that is set in their textbooks. Fleisch, Taylor, Herholdt and Sapire (2011) reviewed empirical evidence by Abadzi (2006) to determine the importance of textbooks in improving learner outcomes. Results of studies conducted in Nicaragua, the Phillipines, Fiji, Brazil, Ghana, and Guinea were consistent in that learner performance improved when sufficient textbooks were supplied (Abadzi, 2006). In support of the supply of adequate textbooks, it has been argued that they help to reduce the instructional time that is often wasted by the teachers having to copy information from the textbook onto the chalkboard.

On the other hand, a study by Glewwe, Kremer and Moulin (2007) found that textbooks may not necessarily result in increased learner performance. Their study established that the availability of textbooks only increased the performance levels of those learners who were academically strong, even in the absence of textbooks. The average or weak learners did not register any gains or improvement as a result of the use of the textbook. This is a surprising outcome, because it is generally believed that the provision of textbooks leads to improved learner performance, and is one reason often cited for investing heavily in school textbooks. Perhaps more research needs to be done in this regard.

Thus, Lawrence (2011) cautions that advocates of textbooks should realise that the effectiveness of these resources is dependent on a number of factors, namely, whether the textbooks are pedagogically and culturally appropriate, whether the teachers know or have been trained how best to use them, and whether the learners have the opportunity to use the textbooks both at school and at home.

2.7 WHAT CONSTITUTES THE EFFECTIVE USE OF MATHEMATICS TEXTBOOKS IN TEACHING AND LEARNING?

The literature that the researcher reviewed indicated that most studies have addressed the question of what constitutes effective mathematics teaching, rather than what constitutes the effective use of mathematics textbooks. The concept of effectiveness depends on one's goals of interest, and on what role one plays in the educational system. Thus, the teachers' views of effectiveness can differ in emphasis from those of researchers and policy-makers (Wilson, Cooney & Stinson, 2005).

Commenting on effective teaching, Antony and Walshaw (2009) suggested that effective teachers are those who plan mathematics learning experiences which allow the learners to build on their existing interests and experiences, which place obstacles in the way of solutions, and understand that learners will make mistakes. Effective mathematics teaching, therefore, should allow the learners to think for themselves, to ask questions and to take calculated risks as they learn to solve problems. But effective teachers should also take the learners through the correct paces in solving some exemplary tasks, and design task progression from simple and familiar to the solution of more difficult problems from the textbook, as well as providing for expanded opportunities for the brighter and more capable learners. Furthermore, as Ying and Young (2007) cautioned, textbooks are not always complete and comprehensive, so teachers have to learn to adapt the content to suit the needs and levels of their learners.

However, there is consensus that the quality of the use of the mathematics textbook can be judged on two criteria, namely desirable outcomes in the students' learning, and the processes that yield those outcomes (Cai, Kaiser & Wong, 2009). These desirable outcomes include what

the Department of Basic Education (2013b) labelled as *conceptual understanding* and *procedural fluency*. *Conceptual understanding* is when a learner comprehends the mathematical concepts, operations and relationships. *Procedural fluency* entails the ability to accurately use different methods to solve a problem, for example subtraction, that involves ‘borrowing’, or addition, that involves ‘carrying’. This corresponds with what Van de Walle (2007) called ‘teaching for understanding by promoting reflective thought’ (p.29). In order to achieve these outcomes, Van de Walle stated that the learner has to be actively engaged during the whole-class discussion, small group-work, and individual exercises.

Woolfolk (2010, p.8) expected the teachers to adapt their instruction to the learners’ needs, to teach in such a manner that even abstract concepts become real and understandable, and that “they are reflective – they constantly think back over situations to analyze what they did and why, and to consider how they might improve learning.” Implicit in Woolfolk’s expectations is that teachers should be both socio-culturalist and constructivist in their approaches to teaching. One of the research questions in this study sought to make the mathematics teachers reflect on how they used the mathematics textbooks, and why they do so.

It has also emerged from the literature that some teachers used their mathematics textbook in its entirety, covering it from the first page to the last, while other teachers used it in combination with other resources. Also, some teachers guided the learners through the lessons as they are presented in the textbook, and give answers to check if the learners’ work is correct, without any discussion on the process that led to those answers.

Interestingly, Santos et al. (2006, p.800) found that only two out of twelve teachers who were observed and interviewed in their study adhered to the prescriptions in the *National Primary Mathematics* textbook, as expected by Mexican authorities, in the following respects, namely

- using the problematic situation of each textbook lesson as a starting point for each topic they had to address;
- encouraging the students to discuss the textbook ideas and to work in teams or small groups;

- analysing the process, and not only focusing on the answers; and
- helping the students to construct their content knowledge through the activities.

Underlying these expectations is the need to promote problem-solving skills in the learners, and also social learning, and making the teachers more of facilitators as the learners construct their own knowledge.

The Mexican authorities' expectations on textbook use listed above are in concert with Van de Walle's (2007, p.48) caution to teachers to avoid the "myth of coverage." In other words, the textbook is a book to use, and not necessarily a book to 'cover'. The teachers are therefore encouraged to use the mathematics textbook as a resource, and should either look for other textbook resources, or design their own tasks using those in the textbook as examples.

It was the purpose of this study to ascertain the extent to which teachers in the Mashonaland East Province of Zimbabwe followed the views discussed above when using the *Step in New Primary Mathematics Grade 7* textbook

2.8 SUMMARY

In this chapter the importance of textbooks as a dominant resource for both teachers and learners, particularly in developing countries, was discussed. The social constructivist theory and other models on textbook use by Johansson (2006), Lee (2011), Rezat (2009), and Stein and Kaufman (2010), were reviewed. Studies that were conducted on the patterns and practices of the teachers' mathematics textbook use in several countries were discussed. A number of factors that influence how the teachers used the mathematics textbooks were identified and discussed, for example the teachers' pedagogical content knowledge, their years teaching experience, the teachers' confidence, and pressure from the school administration and parents. The likely impact of using new textbooks on mathematics teaching and learning was reviewed. Lastly, a brief overview was given of what would constitute the effective use of mathematics textbooks in teaching and learning.

In the next chapter the research methodology that was used in the study will be discussed.

CHAPTER 3

RESEARCH METHODOLOGY

In this chapter will be discussed the methods used to investigate the teachers' use of the *Step in New Primary Mathematics Grade 7* textbooks in the schools in the Mashonaland East Province in Zimbabwe. The following aspects will be described, namely the research design (section 3.1), the data-collection instruments (section 3.2), the data collection procedures (section 3.3) and the ethical issues (section 3.4). The pilot study (section 3.5), that was conducted before the main study, is described, followed by a description of the main study sample (section 3.6), the quality of the data (section 3.7), and the analysis and interpretation of the data (section 3.8). Lastly, a summary of chapter 3 is provided.

The study was guided by three research questions, as listed below.

1. In what ways do grade 7 teachers use the *Step in New Primary Mathematics Grade 7* textbooks in their teaching?
2. What factors influence how the grade 7 teachers use the mathematics textbooks?
3. What impact has the use of the *Step in New Primary Mathematics Grade 7* textbooks had on the teaching and learning of mathematics?

3.1 THE RESEARCH DESIGN

A *research design* refers to the “plan for selecting subjects, research sites, and data collection procedures to answer the research question(s)” (McMillan & Schumacher, 2010, p.102). In this study the purpose of the research design was to decide how many schools and teachers would constitute a reasonable sample in order to describe how the mathematics textbooks are used.

In this study the survey design consisting of mixed methods was used, together with triangulation, namely the collection of both quantitative and qualitative data. Molina Azorin and Cameron (2010) referred to Plano Clark (2005), who explained the mixed method research as the design that combines both quantitative and qualitative data collection and analysis within a

single study. Also, Creswell and Garrett (2008, p.322) provided a useful working definition, namely that *mixed methods* is “an approach to inquiry in which the researcher links, in some way (e.g. merges, integrates, connects) both quantitative and qualitative data to provide a unified understanding of a research problem”. MacMillan and Schumacher (2010, p.25) observed that an advantage of mixed-method designs “is that they can show the result (quantitative) and explain why it was obtained (qualitative)”. Therefore, the overall purpose of using mixed methods was that two approaches provided a better understanding of the research problem than either approach alone (Creswell, 2008; Creswell, 2012; Creswell & Plano Clark, 2011; Greene, 2007).

The researcher used questionnaires to collect large amounts of data on teacher textbook use, while in the interviews the teachers could explain and justify their use of the textbooks, and the challenges they experience. The lesson observations made it possible for the researcher to see first-hand how the textbooks were used within the classroom contexts, something which the questionnaire and interviews cannot do.

Mixed methods research has strengths which offset the weaknesses of both quantitative and qualitative research (Creswell, 2008). For instance, quantitative research “is weak in understanding the context or setting in which people talk, plus the voices of participants are not directly heard” (Creswell, 2008, p.9). The researcher resolved this weakness by means of the use of qualitative methods. However, qualitative methods often make use of a small number of participants in a study, thereby making it difficult to generalise the findings to a larger group. For instance, only six teachers participated in the interviews and the lesson observations, compared to ninety teachers who responded to the questionnaires.

Although mixed methods research is costly in terms of the time it takes and the resources needed to collect and analyse the data, the value of using this methodology far outweighs the difficulties associated with its use. This was indeed the researcher’s experience, as it was possible to obtain alternative explanations and clarification through the interviews and the personal observations in the mathematics classrooms, something not possible when using questionnaires alone.

Furthermore, Creswell (2008, p.13) argued that the collection of both quantitative and qualitative data is important because “audiences such as policy makers, practitioners, and others

in applied areas need multiple forms of evidence to document and inform the research problems.” Therefore, the findings from this study are likely to inform policy-makers and teachers on more efficient ways of using new mathematics textbooks. The data from the questionnaire responses are presented in tabular form, which make it easy to make sense of the findings at a glance. Readers keen on detail may be able to read the accompanying descriptions and analyses of the findings in the interviews and lesson observations.

Moulton (1994) commented that it is difficult to ascertain how the teachers make use of the textbooks without actually observing them doing so. Likewise, it is difficult to find out what teachers think and say about their use of the textbooks without actually interviewing them. Observing how different teachers used the *Step in New Primary Mathematics Grade 7* textbooks and asking them why they used them as they did would reveal significant information about the teaching-learning process and how it can be improved. There was an added benefit to this approach, namely as a manner of resolving the conflict between how teachers reported their use of the textbooks in the questionnaires, and how they were observed using them. Experience has shown that teachers tend to exaggerate their use of textbooks when asked in questionnaires, and this has implications for the analysis and interpretation of the data where the data were generated only by means of teacher questionnaires (Moulton, 1994, p.vii). Therefore, along with the benefit of triangulation in mixed methods research is *complementarity*, which helped to explain and clarify the results from one method with the findings from the other methods (Moon & Moon, 2004).

3.2 DATA COLLECTION INSTRUMENTS

In this section the instruments which were used in collecting the data will be discussed. The questionnaire, semi-structured interview and lesson observation were used. The choice of these methods was informed by the argument presented above, namely that together they would provide complementary and more complete data than when using only one method.

These instruments will be described in the next section, together with an account of what was collected in making use of them.

3.2.1 The questionnaire

A *questionnaire* is a written set of questions or statements on a standard form which respondents answer mostly in writing. Gray (2004, p.187) described a *questionnaire* as “a research tool through which respondents are asked to respond to similar questions in a predetermined order.” The researcher’s questionnaire was informed by this. He used closed and open-ended questions and a rating scale. The questionnaire is the most commonly used technique for obtaining information from respondents (McMillan & Schumacher, 2010). This is because they give large numbers of responses relatively easily, the questionnaires are time-efficient to administer, and they enable the anonymity of the respondents, and have the same questions for all the respondents (McMillan & Schumacher, 2010; Roberts & Copping, 2008). The anonymity of the respondents improves the likelihood of obtaining genuine responses from the participants. Pseudonyms were used in the questionnaire of this study. The use of a questionnaire has the added advantage that it reduces bias which may sometimes arise on grounds of the personal characteristics of the interviewer. Furthermore, the analysis of questionnaire data is likely to be more straightforward (Roberts & Copping, 2008). It is because of these advantages that the questionnaire was used in this study.

However, there are limitations associated with the use of questionnaires. For example, questionnaires require very careful wording of the questions in order to avoid misunderstanding on the part of the respondents. Another limitation of the questionnaire is that the researcher is unable to follow up areas of interest, or to question the respondents on responses that are not clear. In some cases the data generated by means of questionnaires may lack depth and detail. The measures that the researcher took to minimise these limitations are outlined in section 3.2.3.

The questionnaire used in this study comprised of three sections. Section A consisted of the demographic information of the respondents and their schools. For example, the questions included information on the teachers’ gender, age, qualifications, years of teaching experience, and whether they were teaching at a rural, peri-urban, or urban school. Section B consisted of twenty questions on a 6-point Likert-type frequency scale, on how the teachers used the *Step in New Primary Mathematics Grade 7* textbook, where 6=always; 5=very frequently;

4=occasionally; 3=rarely; 2=very rarely; 1=never. McMillan and Schumacher (2010) support the absence of the ‘undecided’ or neutral choice on the Likert scale, because some respondents have the tendency to cluster their answers in this middle category. The six-point scale thus has the advantage that none of the respondents could opt for a neutral position (Cohen, Manion & Morrison, 2007). For example, questions in this section wanted the teachers to indicate their extent of agreement on whether they covered the entire textbook content, followed the sequence of the textbook topics, used the textbook to give homework and small group work. Section C consisted of seven open-ended questions. An example of a question in section C is ‘What, in your opinion, needs to be done to make you a better user of the *Step in New Primary Mathematics Grade 7* textbook?’ A copy of the questionnaire is presented in Appendix B. Closed-ended questions are faster to complete and make data analysis easier as responses can be coded quickly. On the other hand, open-ended questions enable respondents to provide potentially ‘rich’ answers, but take up more of the respondents’ time in writing out the answers; and take up more of the researcher’s time to analyse the responses.

3.2.2 Lesson observation

The non-participant observer role gives one the opportunity to “stand back and watch” (Lawson & Philpott, 2008, p.96). Stringer (2008) points out that careful observation enables one to establish a picture of the context, the activities and events occurring within it, revealing details of the setting, and routine activities making up the real world of the teachers and the learners, and how they interact with the curriculum material (that is, mathematics textbooks in this case). The researcher takes note of the frequency of specific types of behaviours, acts, or events using a structured observation schedule so that only detail relevant to the issue being investigated are recorded. This helps to describe the actions of the people, and the context in which they occur. In the lesson observations the researcher saw and recorded in detail all textbook-related interactions, or the actual references to the textbook, and how the textbook was actually used. The frequency of the references to the textbook, the page numbers and the activities or tasks used or skipped on that page, and how they were used (for example in a worked out example or in individual class work) were recorded. Observation was also useful for investigating non-verbal behaviour, like copying or solving a problem from the textbook on the chalkboard. Moreover, it

provided first-hand evidence of behaviour as opposed to reported behaviour as in questionnaires. The observation method was helpful in corroborating the questionnaire and interview responses.

One of the limitations of the observation method is that observer bias may affect the observation. Besides, people rarely act or behave the same when they know they are being observed. Observation as a method may not provide full explanations for observed behaviour and, therefore, may need to be combined with other methods (Roberts & Copping, 2008). The researcher held pre- and post-observation interviews with the teachers whose lessons he observed in order to mitigate these limitations. An inevitable limitation of the observation method is that it is time-consuming. A lesson observation requires from the observer to sit in at the lesson from the start to the end in order to capture all the activities and events taking place. Each lesson lasted thirty minutes.

Appendix D contains a copy of the lesson observation instrument that was used in this study.

3.2.3 The development of the questionnaire and the lesson observation instrument

Both the questionnaire and the lesson observation tool were adapted from those developed for the Middle School Mathematics Study, University of Missouri-Columbia (Chavez-Lopez, 2003, p.176-186, 191-210). Some of the items on the questionnaire were constructed based on the literature reviewed. Examples are closed-ended item 7, on the use of learners' background when explaining textbook concepts; item 10, on using the textbook to develop the learners' correct mathematical language; and item 12, on encouraging the learners to solve problems from the textbook on their own (see Appendix B).

The questionnaire was given to five experienced grade 7 mathematics teachers to read, to modify, to add to, or to remove irrelevant items. In addition, a pilot study was conducted to help improve the quality of these instruments. This exercise resulted in a reduction of the number of questions, and it resulted in clearer questions being formulated. For instance, one of the original questions was, 'Considering all the professional development you have had during the past 12 months, in what way was learning to use the textbook when teaching mathematics emphasised?'

This was revised to a closed-ended question, namely ‘Regular professional development workshops on how to use mathematics textbooks in teaching are conducted in my province’ (see question 14, section B). In addition, the questionnaires were piloted with ten (10) teachers drawn from schools in the province where the main study was later conducted. Piloting helped to further refine, and to reduce the number of questionnaire items. Initially there were thirty-three (33) closed-ended questions and eleven (11) open-ended questions. The final questionnaire consisted of twenty (20) closed-ended and seven (7) open-ended questions.

Part of this observation tool included items that fitted in very well with Rezat’s (2009) framework on activity theory, as discussed in the literature review (see section 2.3.2). For example, Rezat proposed a standard recording format for observed textbook use and textbook mediation by the teacher in the mathematics lessons, namely reporting on the page or the section of the textbook that was used or referred to in the lesson, the duration or frequency of use, the activity or content used, how it was used, and remarks.

3.2.4 Semi-structured interviews

Interviews involve a conversation between two people, usually in a face-to-face meeting. The interviewer seeks answers to questions from the interviewee. Interviews can be structured, semi-structured or unstructured (Lawson & Philpott, 2008; Maree & Pietersen, 2013). Semi-structured interviews were used in this study.

Semi-structured interviews make use of a set of standard questions, but allow one to add questions or to probe, in response to answers that have been given (Lawson & Philpott, 2008). In general, interviews have the potential to generate detailed data, especially when there is a trusting relationship between the interviewer and the interviewee.

In this study the interview was considered an ideal manner for obtaining first-hand information from the teachers on how they used the *Step in New Primary Mathematics Grade7* textbooks and why they used them in that way. Both verbal and non-verbal behaviour (for example pausing, frowning or hesitation before answering a question) were noted in the face-to-face interviews.

One disadvantage of using interviews as a research method is that they are time-consuming for both the researcher and the participants. Another problem with interviews is their potential for bias and subjectivity (McMillan & Schumacher, 2010). The researcher's and not the interviewees' perspectives and interests may dominate the interview sessions. Furthermore, the transcription of interview proceedings takes time, and the analysis of the interview data can be complex.

Semi-structured interviews were used in this study because they allowed the researcher to add questions as the conversations unfolded, and helped the researcher to gain more insight into how and why the grade 7 teachers interact with mathematics textbooks in the ways they do. The semi-structured interview does not assume that the researcher knows all the right questions to ask before he or she starts. Therefore, this type of interview may reveal additional and previously unanticipated information to be gathered. Examples of lead interview questions were, 'What do you use this textbook for?' 'Do you use all the activities in this textbook? Why, or why not?' 'What percentage of the textbook content do you cover in a year?' Appendix C contains the interview questions.

3.2.5 The development of the interview instrument

The interview questions were constructed similar to those used in the questionnaire. First the questions were given to five experienced grades six and seven teachers to read and to edit for clarity and relevance of content. Thereafter the interview questions were piloted for clarity, and to estimate the length of each interview session. These two measures resulted in a reduction in the number of leading questions from nineteen to fourteen.

3.3 DATA COLLECTION PROCEDURES

The researcher obtained permission to conduct research from the Research Ethics Committee at the University of South Africa. Using this letter, permission was granted to conduct both the pilot study and the main study by the Ministry of Education, Sport, Arts and Culture Head Office

in Harare (Zimbabwe), the Mashonaland East Education Provincial Office, the District Education Offices, and from the Heads of the schools. Appendices G, H, I and J include copies of these letters. The researcher held meetings with the school Heads and the participating grade 7 teachers to brief them on the purpose of the study and to build trust. After this first meeting the researcher visited the six schools once more to familiarise himself with the procedures of the schools, and to build rapport with the participating teachers. Then the interviews and lesson observations were conducted.

3.3.1 The questionnaire

The researcher distributed ninety (90) questionnaires to eighteen sample schools by personally delivering them to the teachers at these schools. Attached to each questionnaire was a letter which explained the nature and purpose of the study, requesting the teachers to sign if they were willing to participate in the study (see Appendix A). The teachers were not forced to participate.

The respondents were allowed a period of one week to complete and return the questionnaires. For anonymity purposes, each respondent was asked to enclose the completed questionnaire into the envelope supplied, seal it and drop it in the sealed box provided in the school office. The researcher then visited the schools again to collect all the questionnaires. This method was preferred because it ensured a high return rate of the questionnaires, and the one week interval enabled the teachers to complete the questionnaires freely and in their own time. Asking people to complete questionnaires while you wait raises validity questions because they either write anything just to get it done, or they may be unwilling to give certain kinds of answers if they are to return them directly to you, the researcher (Lawson & Philpott, 2008).

3.3.2 Lesson observation

The researcher observed six grade 7 teachers teaching mathematics, using the *Step in New Primary Mathematics Grade 7* textbook. The teachers were drawn from six different schools, two each from a rural, a peri-urban and an urban district in the Mashonaland East Province. How

each teacher used the textbooks was recorded on the observation schedule, which included taking notes on the aspects listed below, namely

- the teachers' frequency of making use of the tasks in the textbook;
- the section or page of the textbook used;
- what it was used for, or the ways of using the textbook;
- whether the teacher restructured the textbook task;
- how the teacher restructured the textbook task; and
- whether the teacher used materials other than the textbook, and if so, what materials and how they were used.

Both the lesson observation and interview proceedings were also audio-recorded, with the consent of the teachers. All the verbal and non-verbal behaviour in respect of the use of the textbook were then transcribed literally. Observations were done in classrooms at the sample schools, and during the grade 7 mathematics lessons. Each teacher was observed once. Class visits were arranged in advance so that the lesson observations did not clash with test periods or other school activities. This was done in recognition of the ethical requirement to respect the study sites.

3.3.3 Interviews with the teachers

At the start of the interview the researcher explained the purpose of the study to the participants, guaranteed their confidentiality and anonymity, and allowed them to ask any questions or express any concerns, as well as letting them decide on suitable venues for our interview sessions. These interviews were held with the same six teachers whose lessons were observed. Both pre-and post-lesson observation interviews were held with the teachers. The purpose of the pre-observation interviews was to ascertain what the teachers said they used the textbooks for, how, and why. Each interview lasted thirty minutes on average. These interviews also sought to establish the participants' perceptions of the textbooks after having used them for approximately two and a half years, the problems (if any) they were experiencing in using these textbooks, the support that they received from their district/province offices, and whether they were using other

materials besides or in addition to the *Step in New Primary Mathematics Grade 7* textbooks.

The post-observation interviews helped to follow up on the teachers' decisions relating to the use of the textbook as observed in the lesson, and also to follow up on information arising from the initial interview. The nature of the post-lesson observation questions varied from one teacher to another, depending on the issues that emerged during the lesson observation. The post-observation interviews lasted between ten and fifteen minutes. The tape-recordings were complemented with note-taking for observed behaviours or gestures (body language) that could not be audio-recorded. This approach helped the researcher to capture the entire conversation.

The quantitative and qualitative data for the main study were collected concurrently over a three week period. In support of this approach to data collection Ivankova, Creswell and Plano Clark (2013) argued that it takes less time than, say, the sequential design.

3.4 ETHICAL ASPECTS

Research ethics refers to the “epistemic imperative” (Mouton, 2004, p.239) or the moral commitment that researchers are required to make in the search for truth and knowledge. Stringer (2008, p.44) pointed out that “the research design includes ethical considerations that protect the well-being of research participants.” Ethics gives the researchers guidelines on how they should conduct their research. This researcher was cognisant of these guidelines at every stage of the study in respect of informed consent, confidentiality and anonymity, possible harm to the respondents, voluntary participation, respect for the study sites, and the honest reporting of the findings.

3.4.1 Informed consent

Informed consent is an ethical requirement which ensures that the participants are free to take part or not to take part in a research project (The British Educational Research Association, 2004; The University of South Africa, 2007). The participants have to be given all the information about the aims or purpose of the study, as well as how the study results will be used.

The researcher gave the participants a letter of informed consent (see Appendix A). This letter contained information on the research topic, the purpose of the study, what the participants were expected to do, the fact that their participation in the research was voluntary, that they had a choice to participate or not; or to withdraw from the research or part of the research at any stage. The consent form specified that the names of participants and of their schools would not be divulged to anyone, and that the information provided in the questionnaires, interviews and lesson observations would be confidential. The participants were asked to sign the consent form as an indication of their willingness to take part in the research.

3.4.2 Confidentiality and anonymity

Mouton (2004) pointed out that the respondents should be protected from all possible harm by observing the principles of confidentiality and anonymity. *Confidentiality* refers to the information gathered from the participants being kept private, whereas *anonymity* ensures that the identity of the research participants is kept secret. The participants had the right to remain anonymous, regardless of the data-gathering methods used. Confidentiality and anonymity were achieved by not requiring the participants to write their names or the names of their schools on the questionnaires, as well as in the research report. The appropriate storage of research data also helped to ensure confidentiality and care. Furthermore, the participants' privacy was achieved through disguising the sources of information by using fictitious names and reporting information in a general way, so that no-one could match a given response to a particular respondent or school.

3.4.3 Respect for the study sites

The guidelines of the British Educational Research Association (BERA, 2004, p.8) state in part that "researchers must seek to minimise the impact of their research on the normal working and workloads of participants." Accordingly, permission was sought and granted from the school authorities prior to the commencement of the study. Furthermore, the researcher made every effort to manage the time prudently, for example, by arriving early for his appointments at each school, in order to use as little of the participants' time as possible during the collection of the

data. This also ensured minimal disruption of the everyday class sessions.

3.4.4 Honest reporting of the findings

It is ethical practice to report the findings of both the pilot study and the main study in an honest manner, without any changes or alterations. Honest reporting is important, not only for the final research report, but also when reporting in journal articles and in conference proceedings (Ogbonnaya, 2011). The researcher was fully aware of this requirement throughout this study.

3.5 THE PILOT STUDY

Before the main study was conducted, the researcher did a pilot study. Thabane, Ma, Chu, Chang, Ismaila, Rios, Robson, Thabane, Giangregorio and Goldsmith (2010) described a *pilot study* as an investigation designed to test the feasibility of methods and procedures for later use on a large scale. Also, an African proverb from the Ashanti people in Ghana cautions that “You never test the depth of a river with both feet” (Thabane et al., 2010, p.1). Thus, the major goal of pilot studies is to assess their feasibility so as to avoid the possible pitfalls of embarking on a main study which could ‘drown’ all your research effort. Although a pilot study is no guarantee of success in the main study, it greatly increases the likelihood of such success (David & Sutton, 2004; Pratt & Loizos, 2003; Simon, 2011). All the ethical aspects discussed in section 3.4 were observed.

The pilot study was carried out in order to

- test and improve the clarity of questions in the questionnaire and interview schedule;
- estimate the likely costs of the study; and
- assess the amount of time required for completion of the questionnaire and the interview.

Eleven pilot study participants were drawn from five schools all situated in the Mashonaland East Province of Zimbabwe. The participating schools and teachers fell within the same province

or population that was the target of the main study, and were also drawn from the three strata, namely the urban, peri-urban, and the rural/farming environments. These schools and teachers did not participate in the main study in order to avoid contamination, which arises when data from the pilot study are included in the main study results, or when the participants in the pilot study are included in the main study, but new data are collected from these people.

Although two teachers had agreed to the researcher observing their mathematics lessons, both later declined, citing the fact that it was still too early in the year, and that they were still busy with the class registers, schemes of work and lesson planning. This was a valuable clue to the researcher that the main study should ideally not be conducted too early in any given term. The results of the pilot study proved that it was feasible to conduct the main study.

Concerning each purpose of the pilot study, the teachers' responses and comments on the research instruments led to a reduction in the number of questions in the questionnaire, and fewer leading questions (see section 3.2.3). Secondly, the estimate costs of the data collection stage (visiting the Ministry and District Education offices, printing letters of consent, questionnaires, observation schedules, travelling to the research sites, stationery) were US\$540. The revised questionnaire was likely to be completed in 15-20 minutes, and each teacher interview session lasted between 25 and 30 minutes on average. Galesic and Bosnjak (2009) recommended that the research instruments should not take too much of the respondents' time, lest they feel less inclined to participate.

3.6 THE MAIN STUDY SAMPLE

The study population was the grade 7 teachers in the Mashonaland East Province in Zimbabwe. The eight districts in this province were placed in three categories, namely rural, urban, and peri-urban. Then purposeful sampling was used to obtain a district in each category. The schools in this study were then selected from each of the three districts in the sample. The sample was as indicated in Table 3.1.

Table 3.1: Sample for the main study

	Questionnaires	Lesson observation+ Teacher interview
District1 (rural/farming)	30 teachers	2 teachers
District 2(urban)	30 teachers	2 teachers
District 3 (peri-urban)	30 teachers	2 teachers
Total	90 teachers	6teachers

The eighteen (18) primary schools where these teachers were teaching were the research sites. Two schools or teachers per district were randomly identified from a stratified purposeful sample, and they were interviewed and also observed while teaching. The names of the districts are not mentioned here for ethical reasons, but they covered the rural/farming, urban, and peri-urban strata. The same teachers were also part of the 90 who completed the questionnaires. This helped in that the data collected from the same individuals “can be more easily converged or compared” (Creswell, 2008, p.119). In this study the data from the questionnaires could be compared or corroborated with information gathered from the teacher interviews and lesson observations. However, the sample size for the quantitative data collection was much bigger (90 teachers) than that of the qualitative aspect (6 teachers), and this set a limitation on the extent of comparison or corroboration that could be made.

The size of the sample was small because it had to be manageable in terms of the researcher’s limited time and financial resources.

3.6.1 Description of the research sites

The majority of the schools were clearly sign-posted, including the name of the school, the school’s motto, school direction and distance from the main or tarred roads, the visitors’ parking area, and directions to the school’s administration block. Accommodation for the teachers is provided at the rural/farm and peri-urban schools.

One of the participating schools was a farm school with an enrolment of only 200 learners and

four teachers for grades 0 to 7. This school had composite classes, and the grades 6 and 7 learners were accommodated in one class. There existed a high rate of learner absenteeism, because the farmers were busy with weeding and tobacco harvesting. The grade 6 and 7 teacher at this school was one of the six selected for the interview and lesson observation. This farm school was the only one within the sample with a low enrolment; the rest of the schools had between two and ten grade 7 classes. Altogether six urban, seven rural/farm and five peri-urban schools participated in this study. Apparently, teacher allocation in all the schools favoured the grades 6 and 7 classes, as they were taught by relatively well qualified and experienced teachers. The same was observed in relation to furniture allocation. The learners mostly sat on wooden benches and in group formations around a table or a cluster of desks. There was ample evidence of adequate *Step in New Primary Mathematics Grade 7* textbooks and exercise books for all the learners.

Nearly all the urban and some peri-urban schools in this study were characterised by double sessioning (or hot-sitting). This is an arrangement where there are two sessions per day, with some classes attending school in the morning and others in the afternoon. An advantage of this set-up is greater economies of scale, since the same facilities are shared by a bigger number of learners. All the schools were day schools, except two which were boarding schools, one urban and the other peri-urban. On average there were 40-50 learners per class, although the official class size is 40. At a number of schools some classes for the lower grades were being conducted outside, (under the trees), though there was evidence of work-in-progress to construct additional classrooms. At one urban school the staffroom had been converted into a classroom. Subject teaching, where every teacher in grades 4 to 7 specialises in the teaching of one subject, was practised at only one school.

3.6.2 Description of the participants

All the 82 teachers who completed and returned the questionnaires were trained teachers, with qualifications ranging from a Certificate in Education (9), a Diploma in Education (48), a Bachelor's Degree in Education (24) to a Master's Degree (1) (see Table 4.2). The number of years of teaching experience of these teachers varied from 5 years to more than 15 years. Details

of the six teachers who were interviewed and whose lessons were observed are provided in Table 3.2. The names of the teachers are pseudonyms in order to observe their anonymity and confidentiality.

Table 3.2: Demographic information of the teachers who were interviewed and observed

Teacher's name	Gender	Age range	Qualification	Teaching experience	School type
Mr. Badza	M	35-40 years	Diploma in Education	14 years	Rural (Council)
Mrs. Demo	F	50 years+	Certificate in Education	Over 15 years	Rural/farm (Council)
Ms. Mbezo	F	35-40 years	Diploma in Education	5 years	Peri-urban (Council)
Ms. Pfumo	F	41-45 years	Diploma in Education + Bachelor of Education	11 years	Peri-urban (Council)
Mr. Banga	M	46-50 years	Diploma in Education	Over 15 years	Urban (Government)
Mrs. Gano	F	50 years+	Certificate in Education + Bachelor of Education	Over 15 years	Urban (Government)

3.7 QUALITY OF THE DATA

Whereas validity and reliability can be used to describe the quality of the questionnaire (quantitative) data, the term *trustworthiness of data* applies to interviews and observations (qualitative), (Trochim, 2006).

3.7.1 The validity and reliability of the questionnaire

Validity refers to establishing that the particular type of measurement used is closely related to what is being measured (McMillan & Schumacher, 2010). *Validity* is also concerned with whether the sample used in a research study is a reasonable representation of the cross-section of the whole population (Lawson & Philpott, 2008). This requirement was observed in the choice of the research sample, as outlined in paragraph 3.7 (see also Tables 3.1 and 3.2).

The validity of the questionnaire was enhanced through piloting to clarify the questions and instructions to the respondents, obtaining the expert opinion of experienced mathematics teachers, and by allowing the respondents more time to complete the questionnaires.

Reliability refers to the consistency of the measuring instrument used, and the ability of the research results to be replicated. The reliability of the questionnaire was determined by using the test-retest method. Shuttleworth (2009) pointed out that the test-retest method is one of the simplest ways of testing the stability and reliability of an instrument over time. This method measures consistency from one situation to the next. The same instrument is administered twice to the same group of people and under the same conditions, but with a reasonable time interval between the two administrations in order to minimise the “memory effect” (Pietersen & Maree, 2013, p.215). The two sets of scores obtained are then correlated.

The test-retest reliability was determined after the pilot test. The questionnaires were administered to ten grade 7 teachers in the Mashonaland East Province. The questionnaires were re-administered to the same grade 7 teachers after four weeks. A Pearson’s Product Moment Correlation Coefficient (r) was calculated to determine the reliability of the questionnaire. The results are presented in Table 3.3. Pearson’s correlation is computed with interval scale measures. The Likert scale used in this questionnaire is inherently an ordinal scale measure. The assumption that the researcher made in treating the questionnaire instrument as if it were an interval scale was that the 6 levels on the Likert scale could be assigned values as on a continuum from 1 (never) to 6 (always).

Table 3.3: Grade 7 teachers' test-retest scores

Teacher	Test 1 (X)	Test 2 (Y)
1	84	80
2	81	84
3	66	61
4	78	81
5	70	74
6	79	73
7	64	68
8	82	79
9	68	74
10	70	75

The results of the test-retest scores yielded a correlation of 0,79. This indicates an acceptable level of reliability, because the value is closer to one than to zero (Pietersen & Maree, 2013).

3.7.2 The trustworthiness of the interviews and the lesson observations

Trochim (2006) commented that no benchmark exists in qualitative research which can measure repeatability, or upon which to establish reliability. Also, Stringer (2008) presented a set of criteria for establishing the quality of data in research, particularly in qualitative research, which was originally proposed by Lincoln and Guba (1985). They suggested that “because there can be no objective measure of validity, the underlying issue is to identify ways of establishing trustworthiness, the extent to which we can trust the truthfulness or adequacy of a research project” (Stringer, 2008, p.48). In this regard Lincoln and Guba proposed that establishing trustworthiness involves procedures for attaining credibility, dependability and confirmability (Stringer, 2008). These procedures were taken into account in this study, as explained below.

- **Confirmability**

The raw data gathered in this study - in the form of field notes from the lessons observed and interviews, audio-recordings, questionnaire responses and other written correspondences- were stored in a safe place. This is what Lincoln and Guba (1985) called *an audit trail*. In the event that interested parties at any time may want to confirm that the research is an accurate representation of the views expressed by the participants, the researcher would make these records available.

- **Dependability**

To a very large extent the presentation and the analysis of the data in this study reported the exact words and expressions used by the research participants. This helped to explain the experiences, practices and perspectives of the participants, using their own words.

- **Credibility**

Credibility implies the plausibility and integrity of a study (Stringer, 2008). Mertens (2005), Stringer (2008), and Lincoln and Guba (1985) listed prolonged engagement, persistent observation, triangulation, participant debriefing, and member-checks as strategies for establishing credibility. These strategies and how the researcher applied them in this study are explained next.

- **Prolonged engagement**

Prolonged engagement requires from the researchers to spend a reasonable amount of time with each research participant at the research sites in order to get to understand the context better, and to build a good working relationship with the participants. In addition, prolonged engagement allows the researcher to ‘gain greater insider knowledge rather than the often superficial information given to strangers’ (Stringer, 2008, p.49). Accordingly, the researcher spent one

week during the pilot study and three weeks on the research sites for the main data-gathering exercise. On average the researcher spent ninety minutes with each teacher during the interviews and lesson observations. This was in addition to the time spent at the Mashonaland East Province and District offices seeking permission to conduct research in the province, and obtaining the lists of the schools in each of the districts. During this time the researcher engaged in informal discussions with officials on the use of the *Step in New Primary Mathematics Grade 7* textbook. The highlight of an informal interview that the researcher held with the headmaster of one primary school, as described in chapter 4, is another example.

- **Persistent observation**

This is one requirement of credibility that the researcher failed to comply with, but the mixing of methods helped to counteract this shortcoming.

- **Member-checks**

Member-checking or participant verification is a quality control measure used in qualitative inquiry to improve the accuracy and validity of what has been recorded during an interview (Harper & Cole, 2012). During the interview sessions the researcher constantly restated and summarised the information that was provided by the interviewees, and they were asked to confirm if it was an accurate record of what they had said. The participants either agreed, or disagreed, or offered further explanations.

- **Triangulation**

Niglas (2004, as cited in Molina Azorin & Cameron, 2010) noted that the use of two or more different methods to investigate a phenomenon of interest yields mutually confirming results, and one can be more confident that those results are valid or 'legitimate' (Onwuegbuzie & Johnson, 2006). Similarly, Moebius (2002, as cited in Moon & Moon, 2004, p.7) described *triangulation* as "a vehicle for cross validation when two or more distinct methods are found to be congruent and yield comparable data."

Lawson and Philpott (2008) suggested that one solution to the quality concern in interviews is to make it known to the respondents that even unpalatable but honest responses are welcome. Accordingly, this message was communicated to all the interviewees. The precise recording and literal descriptions of the teacher behaviours in specific situations helped to enhance the validity of the interviews and the lesson observations.

- **Originality and usefulness**

This study was perhaps the first to investigate the teachers' use of the *Step in New Primary Mathematics Grade 7* textbooks in teaching. In that sense it was original. The findings of the study will hopefully be useful in improving teacher training and teacher development, as well as improving the quality of the textbook.

3.8 ANALYSIS AND INTERPRETATION OF THE DATA

The data that were audio-recorded were first transcribed using the “verbatim principle” (Stringer, 2008:99). This principle encourages the use of the exact words that the respondents actually said in the conversations. The data were then coded and analysed in relation to the teachers' use of the curriculum materials -mathematics textbooks in this case (Remillard, 2005).

- **Unit of analysis**

In qualitative data analysis it is necessary to do content analysis in order to reduce the amount of text arising from responses to open-ended questions. To begin with, the researcher identified an appropriate unit of analysis, which is the smallest block of text to examine. He chose “individual teacher” as the unit of analysis. The data were then arranged in such a way that each teacher's responses to each interview question were put together, but each teacher's responses were kept separate.

The first stage of the interview and the analysis of the lesson observation data were data-reduction and management, and it involved sorting the data into categories. The categories were

developed prior to the gathering of all the data, and were based on the research questions, as follows:

- the extent of use of the mathematics textbook;
- the ways the teachers used the mathematics textbook;
- why the teachers used the textbook like that;
- problems experienced in the use of the textbook;
- the teachers' use of resources other than the *Step in New Primary Mathematics Grade 7* textbooks;
- why some teachers did not use this mathematics textbook; and
- how these textbooks impacted on the teaching and learning of mathematics.

The units were classified into categories (for example, assigning homework, the frequency of textbook use, textbook errors) in such a way that each unit belonged to a single category. These categories formed the basis for coding, using terms that expressed the nature of the information in a category, and descriptive accounts to give meaning to the data.

The responses from the open-ended questions on the questionnaire and the lesson observation data were treated in the same manner as the interview data. The closed-ended questions on the questionnaire were coded and analysed, using the SPSS computer programme. SPSS was used to determine the levels of teachers' agreement on the questionnaire items, on a 6-point Likert scale (see section 3.3.1). Chireshe (2006) used Babbie's (1992) definition of coding as the process of transforming raw data into a standardised and quantitative form. The collected data were converted into numerical codes, and each point on the Likert scale was assigned a score. The descriptive statistical analysis included the use of tabulations, graphs, and the computation of frequencies and percentages.

Data analysis for an evaluative study involves description, explanation and judgement (Chikuya, 2007). In concurrent mixed methods the data collected from the different methods have to be reported in an integrated manner. Creswell and Plano Clark (2011) recommended the merging of data, a process of integration which combines the qualitative data in the form of texts, with the

quantitative data in the form of numeric information. In this study integration was achieved by reporting the results together, first the quantitative, statistical results were reported in tabular form, qualified by descriptions based on the interviews and lesson observations. The data were interpreted in the context of the theories, models and findings from recent studies on textbook use, as discussed in chapter 2.

3.9 SUMMARY

The research methodology was described in this chapter. In order to answer the research question, lesson observations, semi-structured teacher interviews and questionnaires were deemed suitable tools to gather the necessary data. The pilot study helped to refine the research instruments and to enhance the process of data collection for the main study. Stratified sampling was used in order to ensure equal representation of rural, peri-urban and urban participants from Mashonaland East Province. Concurrent collection of the quantitative and qualitative data was done, and this helped to maximise on the use of the researcher's limited time. There was full compliance with research ethics at all stages of the study.

In the next chapter the findings are presented, analysed and discussed.

CHAPTER 4

THE ANALYSIS AND INTERPRETATION OF DATA

4.1 INTRODUCTION

The purpose of this chapter is to present, analyse and discuss the findings from the study that sought to evaluate the use of the *Step in New Primary Mathematics Grade 7* textbooks by teachers in the Mashonaland East Province of Zimbabwe in the teaching and learning of mathematics.

In this chapter, the researcher reports on the findings from the questionnaires, the interviews with the teachers and lesson observations. The lesson observations were done for triangulation purposes. The teachers' demographic information is presented first, in Table 4.2. The rest of the findings are reported in section 4.3, under the 3 research questions.

The study was guided by the following research questions:

1. In what ways do grade 7 teachers use the *Step in New Primary Mathematics Grade 7* textbooks in their teaching?
2. What factors influence how the grade 7 teachers use the mathematics textbooks?
3. What impact has the use of the *Step in New Primary Mathematics Grade 7* textbooks had on the teaching and learning of mathematics?

4.2 THE TEACHERS' DEMOGRAPHIC INFORMATION

In this section the biographical details of the respondents are presented. This information provides the context as well as an appreciation of the circumstances in which the data were collected.

Of the 90 questionnaires that were distributed, 82 (91%) were returned. This was a satisfactory response rate, and attributable to the method of distribution and collection that the researcher employed. He personally delivered the questionnaires to the schools. The teachers were given one week to complete them. The anonymity of the respondents and the confidentiality of the information they provided were guaranteed, as outlined in section 3.3.1, chapter 3. The gender balance of the respondents was skewed, since 52 (63,4%) were female and 30 (36,6%) were male. This is probably reflective of the general staffing situation in most primary schools in Zimbabwe, where the majority of the classroom teachers across all the grades are female.

Table4.1: Age range of the respondents by gender

Gender	Age range			
	21-30years	31-40years	41-50years	50years+
Females	9	18	19	3
Males	1	8	19	5
Total	10	26	38	8

Table 4.1 displays the age range of the respondents by gender. The largest group of these teachers were in the 41-50 years age range, and the number of males and females in this age group was the same, namely 19.

Table 4.2: Highest professional qualifications of the teachers

Gender	Highest professional qualification			
	Certificate in Education	Diploma in Education	Bachelor of Education	Master of Education
Females	5	33	14	0
Males	4	15	10	1
Total	9	48	24	1

Surprisingly and contrary to reports in some literature (Christie et al., 2007; Coltart, 2010; Susuwele-Banda, 2005), the teachers who participated in this study were very well qualified, as can be seen from the summary of the respondents' highest professional qualifications in table 4.2. All the 82 teachers had the requisite minimum qualifications for primary school, namely a Certificate or Diploma in Education. In addition to this basic teacher qualification, 21 (25,6%) of them had a Bachelor of Education Degree, and one teacher also had a Master's Degree.

Table 4.3: Teaching experience of the respondents by gender

Gender	Teaching experience			
	1-5 years	6-10 years	11-15 years	15 years+
Female	8	12	9	23
Male	3	1	6	20
Total	11	13	15	43

Most of the teachers in this study had more than 15 years' teaching experience, as indicated in Table 4.3. The teachers' age ranges and their years of teaching experience reflect a fairly mature cohort of respondents. The majority of the respondents, 46 (56%), were 41 years or older (Table 4.1), and 43 (52%) teachers had taught for more than 15 years. Taken together, these attributes of qualifications, age and teaching experience would make one believe that the responses given on the questionnaires and in interviews were objective and genuine. This belief is supported by Chikuya (2007, p.156) who commented that:

The varied teaching experiences further strengthen the researcher's belief that responses would be objective and true if age is anything to go by. The respondents' teaching experiences themselves manifest a deep understanding of what teaching is about and the conditions necessary for its improvement.

It is therefore tempting to conclude that these teachers' quality of textbook use could be expected to be of a superior standard, given their levels of maturity and qualifications, and to some extent their teaching experience.

In the final analysis, each of the rural, peri-urban and urban districts contributed an almost equal number of respondents, namely 26, 28 and 28 respectively.

The schools were drawn from five different responsible authorities, a rural council, town council, government, mission, and board of governors. The distribution of the respondents by responsible authority was 31 (37.8%) at government schools, 35 (42.7%) at rural council schools, 8 (9.7%) at town council schools, 3 (3.6%) at a church school, and 5 (6.1%) at a school run by a board of governors. Two of the government schools –the one urban and the other peri-urban- offered boarding facilities. The rest were day schools.

4.3 PRESENTATION AND ANALYSIS OF THE RESULTS

The results from the questionnaires, the teacher interviews, and the lesson observations on each research question are presented, analysed and discussed below. There were 82 questionnaire responses, six teacher interviews were conducted, and six lesson observations were done. A brief conclusion is provided after the discussion of each research question.

4.3.1 Research question 1:

In what ways do grade 7 teachers use the *Step in New Primary Mathematics Grade 7* textbooks in their teaching?

The teachers used this textbook in a variety of ways, as described in sections 4.3.1.1 to 4.3.1.7.

4.3.1.1 Explaining new concepts and individual class work

The textbook provides worked out examples and a series of exercises on each topic, and the teachers may use these in their lessons, or come up with their own examples and exercises. Closed-ended question 1 sought to ascertain how often teachers use the mathematics textbook to explain concepts and to set individual class work, as reported below.

Table 4.4: Summary of the teachers’ responses on using the textbook when explaining new concepts and giving individual class work to the learners.

Questions		Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q1	I use the textbook to explain new concepts and to give class work to the learners.	Respondents	15	22	19	8	10	8
		Percentage of responses	18%	27%	23%	10%	12%	10%

Table 4.4 shows the teachers’ responses to closed-ended question 1 on the use of the textbook when explaining new concepts and in giving class work to the learners. Fifteen (18%) teachers always used the *Step in New Primary Mathematics Grade 7* textbook to explain new concepts and to give class work to the learners. Also, 22 (27%) of the teachers did so very frequently, 19 (23%) occasionally, eight (10%) rarely, ten (12%) very rarely, and eight (10%) never used this textbook to explain new concepts and to give class work. While the majority of the teachers agreed that they used the textbook during mathematics lessons, it is important to note that a total of 26 teachers stated that they ‘rarely’, ‘very rarely’ or ‘never’ used the textbook in their lessons. This could be indicative of some teachers’ resistance to the use of these textbooks (see section 4.3.3.4), resulting in them using other textbooks. Alternatively, they could be using ideas borrowed from this textbook as reported earlier in the fourth activity system of the tetrahedron model by Rezat (2006) (see section 2.3.2) and by Johansson (2006) (see section 2.3.5), or they used other mathematics textbooks.

The findings from the interviews and the lesson observations revealed that all the six teachers used the textbook in the introductory part of their lessons to explain new concepts, and later required their learners to answer questions from the textbook in their exercise books. This is what the teachers said in the interviews:

Mr. Badza: *I take a worked example from the textbook, copy it onto the chalkboard and explain*

to the learners. At times I just give an exercise and the learners answer the set questions from the textbook, without having to write on the chalkboard.

Mrs. Demo: *I use the textbook for daily exercises. It also gives me examples of how to work out the sum.*

Ms. Mbezo: *I use the textbook to develop concepts, step by step.*

Ms. Pfumo: *I use it for examples and written exercises.*

Mr. Banga: *I use it for the actual teaching process. I refer to its examples and the learners do activities from the textbook during lesson time.*

Mrs. Gano: *You see, I extract my work from there, the daily exercises.*

What these teachers said was confirmed in the lesson observations, as described in the following four summaries out of the six lessons that the researcher observed.

Mr. Badza's lesson.

The learners were asked to produce their mathematics textbooks and to turn to page 17. The teacher had copied two worked out examples from page 17 of the textbook onto the chalkboard beforehand. This is how the teacher introduced the lesson:

Mr. Badza: *Ok, we want to look at addition with carrying, looking at 4-digit numbers. Draw a number line and mark 0-20 on it, which you are going to use to add. (Pause for the learners to draw the number line. The learners used their rulers to draw the number line.)*

Mr. Badza: *When adding with ‘carrying’ we start off with the units, so we start from the right side.*

$$\begin{array}{r} 6345 \\ +2876 \\ \hline = 9221 \end{array}$$

Mr. Badza: *Five plus six?*

The learners (in chorus): *Eleven.*

Mr. Badza: *Raise your hand if you want to give the answer. So you write down 1 and carry 1.*

The 1 that was carried was written just below the answer line, next to the tens column. The process of ‘adding’ and ‘carrying’ continued, with the teacher demonstrating on the chalkboard until the answer was complete. The teacher then read out the answer to the whole class.

Mr. Badza: *So our answer is nine thousand two hundred and twenty one.*

Mr. Badza: *Ok, I am going to give another example, which is $3936 + 1284 =$*

The same procedure that was used in working out the answer to the first example was followed for doing the second example. Thereafter two learners were asked to do questions 3(c) and 3(d) on the chalkboard, and to explain to the rest of the class how they arrived at their answers. Written work was then given for the learners to do in their mathematics exercise books, again taken from page 17 of the textbook.

Mrs. Demo’s lesson.

This was a composite class, with both grades 6 and 7 learners in one classroom. The lesson was a continuation of work begun in previous lessons. It started with the teacher recapping on the kinds of fractions. This was followed by the teacher writing Question 3(a) from page 69 of the textbook on the board. This was used to demonstrate the steps and rules to observe when adding

mixed numbers. The teacher used steps similar to those in a worked out example shown on page 69 of the textbook.

$$\begin{aligned} & 2\frac{1}{8} + 1\frac{5}{12} \\ & = 3\frac{1}{8} + \frac{5}{12} \\ & = 3\frac{3}{24} + \frac{10}{24} \\ & = 3\frac{13}{24} \end{aligned}$$

One learner thought the final answer was $\frac{16}{24}$ instead of $3\frac{13}{24}$! The teacher made no comment on the wrong answer given by this learner.

More work was done on the chalkboard using questions 3(c) and 4(a) on page 69 of the textbook. Question 3(c) is the addition of two mixed numbers, and was to be answered by one grade 6 learner. Question 4(a) is the addition of three mixed numbers and was to be answered by one grade 7 learner. Each learner copied the question onto the chalkboard and also worked it out on the chalkboard, explaining every step, assisted by the rest of the class. Then a class exercise was given, again from page 69. The grade 6 learners were expected to do number 3(a) to 3(e), involving the addition of two mixed numbers only. The grade 7 learners were expected to do number 4(b) to 4(d), the addition of three mixed numbers only. Both the grade 6 and grade 7 learners did the written work from the grade 7 textbook, the only difference being that the questions for the grade 6 learners involved adding two mixed numbers, whereas those for grade 7 learners involved adding three mixed numbers.

An example of the questions answered by the grade 6 learners is:

Question 3(b) $3\frac{1}{4} + 5\frac{1}{5} =$

An example of the questions answered by the grade 7 learners is:

Question 4(b) $29\frac{15}{20} + 13\frac{7}{30} + 5\frac{3}{10} =$

➤ **Post-lesson reflections**

Could the teacher not have used the grade 6 mathematics textbook? Or could she not have asked the grade 7 learners to answer questions with both 2 and 3 mixed numbers? When asked after the lesson why both groups of learners were using the grade 7 textbook, the teacher indicated that the *Step in New Primary Mathematics Grade 6* textbook does not have any work on mixed

numbers. She continued to explain that normally she alternated the use of the grades 7 and 6 textbooks, and on some topics she used only the grade 6 textbook with both the grades 6 and 7 learners. Mrs. Demo's explanation was surprising, because the content in the primary mathematics syllabus is developmental, implying that the grade 6 textbook should have some work on the addition and subtraction of mixed numbers!

The second reason that she gave was:

Mrs. Demo: *The grade 6 learners were actually getting good exposure, and if they were still at school the next year they would fare better in mathematics, because they will be doing this work for the second time. This, it can be argued, is one of the benefits of learning in a composite class.*

Ms. Pfumo's lesson

Step 1.

The teacher used question 4(a) on page 157 to demonstrate how to calculate percentages decreasing from 16 to 12 as follows:

$$\begin{aligned} 16-12 &= 4 \\ &= \frac{4}{16} \times \frac{100}{1} \\ &= 25\% \text{ decrease} \end{aligned}$$

The teacher told the learners that when you decrease, you subtract, then the common fraction must be changed to a percentage; divide using the highest common factors.....and

One volunteer learner was asked to come to the front and to do question 4(b) on the chalkboard.

He wrote the following:

$$\begin{aligned} &75 \text{ to } 70 \\ &=75-70=5 \\ &=\frac{5}{75} \times \frac{100}{1} \\ &=\frac{20}{3} \\ &=6,66\% \end{aligned}$$

The teacher presented a running commentary as the learner did the sum, as follows:

Ms. Pfumo: *Our denominator is the original number before the decrease.*

The final answer of 6,66% was not rounded off to the first or second decimal, but the teacher said nothing about it.

Step 2.

Discount: There was a question and answer session on the meaning of the term 'discount', and when it applied.

Ms. Pfumo: *What does the term discount mean? Even in Shona, tell us what it means.*

Learner: *Mari yaunobvisirwa kana watenga chinhu.* (The money deducted from the sale price when you buy an article).

Ms. Pfumo: *Yes, it is deducted when you pay cash, and this discount is expressed as a percentage, for example 10% discount when there is a sale; no mention of the amount of money, only the percentage. Turn to the picture given on page 157 of a shop which is offering discount: Zama Zama Outfitters. If you look at that picture what items does it say are sold in this shop?*

Learners: *Clothes.*

Ms. Pfumo: *10% off selected goods, meaning they will make you pay 10% less on the sale price. Question 5(a), men's long sleeved shirts @ \$125,50 each. What is a long sleeved shirt? Do you see we have both long and short sleeved shirts in the picture? So first calculate 10% discount, then subtract this from the original price, this gives you the sale price.*

$$\frac{10}{100} \times \frac{125,50}{1}$$

= \$12,55 discount.

So we must now go on to answer the question. Therefore the sale price is \$125,50 - \$12,55 = \$112,95.

This means you saved \$12,55.

Mr. Banga's lesson.

Step 1.

The teacher used his own examples for the demonstration of units of time, starting with the rotation of the earth around the sun. This results in the rising and setting of the sun, giving us the day and the night. Most learners seemed familiar with this naturally recurring phenomenon.

The teacher wrote information on units of time conversions on the chalkboard, based on page 91 of the textbook, and discussed this with the class:

1 day = 24 hours

1 ½ days = 36 hours

24 hours = 24 x 60 = 1440 minutes

1 hour = 60 minutes.

60 sec = 1 min.

Step 2.

One learner was asked to read out question 3(d) on page 92, but read it wrongly twice, first as 302 seconds, and then as 320 seconds, instead of 312 seconds! Instead of assisting this learner to read correctly, the teacher called on another learner to read the question.

Question 3(d): $312 \text{ sec} = \underline{\hspace{2cm}} \text{ min}$

One learner was asked to come to the front and to work out the sum on changing 312 seconds to minutes. Using long division the answer obtained was 5min. 12 sec. Another learner was asked to demonstrate to the class the reverse operation, changing minutes to seconds. In each case the learner was supposed to explain to the rest of the class what he or she was doing or the working at every stage up to the final answer. Both computations were correctly done. Lastly, the teacher gave the class an exercise where the learners had to do questions 3(b), (c), and 4(a) to (d) in their mathematics exercise books.

➤ **Post-lesson remarks**

The focus of this post-lesson discussion was on the good practice of expecting from the learners to read out the question in the textbook aloud, and particularly in the form of assistance or intervention the teacher provides to those who cannot read, as was the case with the boy who failed to read '312 seconds' correctly. Mr. Banga pointed out that such problems are common in his class, and that he always tried to correct the learners' reading mistakes. Often, what they read wrongly was also what they ended up writing in their mathematics exercise books.

4.3.1.2 Textbook use in small group work

The teachers also used the mathematics textbook in small group work.

Table 4.5: Summary of the teachers’ responses on how often they used the textbook in small group work tasks.

Q11	I encourage the learners to discuss the textbook tasks in group work.	Respondents	22	21	24	7	5	3
		Percentage of responses	27%	25%	29%	9%	6%	4%

Table 4.5 shows that twenty-two (27%) of the teachers always used the textbook in small group work, 21 (25%) very frequently used this method, 25 (30%) used it occasionally, while seven ((%) rarely, five (6%) very rarely, and three (4%) never used the textbook for small group work. These statistics reveal that most of the teachers in this study used the *Step in New Primary Mathematics Grade 7* textbook in small group work.

Two of the teachers who were interviewed gave the following responses concerning the use of the textbook in group work:

Mr. Banga: *I refer to the textbook examples and the learners do group activities from the textbook during lesson time.*

Mrs. Gano: *I also use the textbook when the learners do individual or small group work.*

In five of the six lessons the researcher observed the textbook was used in pair work or small group work. The groups ranged in size from two to six learners each. The main observations that the researcher made during the group activities are summarised below.

- The group members read the question from the textbook, discussed it and wrote down the answers.
- The teacher walked from one group to another, to check on the learners’ progress and to

give assistance where necessary.

- Most of the discussions were conducted in Shona, although the final answers were presented in English. This practice is an example of language switching (see section 2.3.1.1).
- A group representative would write the answers on the chalkboard, and explain to the rest of the class how they obtained the answer.
- The groups worked on different questions, but from the same exercise.

In Ms. Pfumo's lesson, one group's answer was incorrect. The group had presented their solution to question 5(d) on page 157 as follows:

$$\begin{aligned} & 10\% \text{ of } \$36,60 \\ & = \frac{10}{100} \times \frac{\$36,60}{1} \\ & = 36,66 - 36,60 \\ & = \$0,06 \end{aligned}$$

Ms. Pfumo had to work out the solution correctly on the chalkboard, with the participation of the learners.

Requiring the groups to report back on their deliberations helps, especially in cases like the above where they worked it out wrongly.

Mr. Banga did not use the *Step in New Primary Mathematics Grade 7* textbook for the group tasks, but formulated his own examples. This practice approximates the fourth activity system (teacher-mathematical knowledge-learner) in Rezat's (2006) tetrahedron model, where the teacher uses his mathematical knowledge and not the textbook directly (see section 2.3.2). The practice is also similar to Johansson's (2006) 'textbook absence' (see section 2.3.5), where a teacher makes connections to other mathematical areas or to everyday life applications which are not explicitly stated in the textbook.

Santos et al. (2006) found that only two of 12 teachers in Mexican schools used the mathematics textbook to assign small group work. In comparison, five of the six teachers that the researcher

observed in the Mashonaland East Province of Zimbabwe used small groups to discuss textbook tasks. Group work helps in the sense that those learners who are too timid to ask the teacher for help or who have language problems can ask their group mates. During group work the learners read from the textbook, interpreted/clarified the problems, and solved them. The report-back sessions enabled further discussions by the whole class, and gave the teacher an opportunity to confirm the correctness of each group's answers. However, in two of the six lessons there were no group report backs, as the teachers moved straight on to individual class work. Thus the group effort counted for nought, since the group's answers could not be shared with the rest of the class, and each group could not get confirmation that all its answers were correct. It is important for the teachers to always bear in mind that the report back phase is a focal point in any group work.

Group work can also be an effective way of getting the learners to work together and to share ideas. In addition, group work is important in many other ways, for example, it promotes co-operation and not competition in the learners. Furthermore, as Susuwele-Banda (2005, p.68) pointed out, "group work maximises students' working time and reduces the teacher's dominance of the lesson; and they (the learners) engage in discussion and disagreements". Also, the co-operative groups enable the teacher to meet one group at a time instead of meeting one learner at a time, and this helps in terms of classroom and time management (Obara & Sloan, 2009). The Department of Basic Education (2013a) posits that the face-to-face interactions in group work allow learners to promote, support and encourage each other's efforts to achieve group goals.

This includes explaining how to solve mathematics problems. Interpersonal and social skills such as listening to others, decision making and communication are developed; and it enhances inclusivity because of its emphasis on the use of heterogeneous groups (Annexure C).

The use of textbook tasks in pair work and group work helps to develop social learning by reading the information in the textbooks together, and discussing and agreeing on common solutions. In support of group work, Sullivan (2009, p.709) noted that it promotes "rich social

interactions with other learners, substantially contributing to opportunities for learning, and students can benefit from either giving or listening to explanations of strategies or results.” This type of work also promotes active learning, which is the result of the dialogue and interaction as learners work through set tasks. The constructivists also agree that the teachers should engage the learners in the collaborative tasks (Carr, 2006; Susuwele-Banda, 2005; Zevenbergen et al., 2004).

Small group discussions help the learners to clarify their understanding of concepts, since they can explain them to each other in ways that make it easy to follow. The constructivists advocate discussion, because it promotes the learners’ development of mathematical language, the construction of more refined concepts, and more active learning (Haggarty & Pepin, 2004; Van de Walle, 2007; Zevenbergen et al., 2004). Therefore, those teachers who ‘never’, ‘rarely’ or ‘very rarely’ encourage small group discussions could be doing the learners a great disservice, and also to themselves.

4.3.1.3 Encouraging the learners to solve the problems in the textbook in their own ways

It is important that teachers always emphasise to the learners that there is more than one strategy or method to solve mathematical problems (Sullivan, 2009). The teachers were asked if they promoted this practice in their lessons. Their responses are indicated and discussed below.

Table 4.6: How frequently do the teachers encourage the learners to solve the problems in the textbook in their own ways?

Q12	I encourage the learners to solve the problems in the textbook in their own ways, as long as they can explain their method.	Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
		Respondents	19	17	12	18	7	8
		Percentage of responses	23%	21%	15%	22%	8%	10%

The teachers were requested to indicate how often they encouraged their learners to solve the textbook problems on their own, provided it leads to the correct answers, and they can explain their methods. As shown in Table 4.6, nineteen (23%) teachers did so always, 17 (21%) very frequently, 12 (15%) occasionally, 18 (22%) rarely, 7 (8%) very rarely, and 8 (10%) never. Quite a significant number of the teachers did not encourage the learners to use alternative strategies to solve textbook problems. This is disturbing, because no method is cast in stone, and the teachers should not only use a variety of methods to solve the problems, but should also encourage the learners to try out other methods as a way of promoting diversity rather than conformity in the solution of mathematical problems. In this regard, Carr (2006) and Susuwele-Banda (2005) agreed with the constructivist thought that one of the teachers' roles should be to focus on the learners' thought processes rather than solely on their ability to reach the correct answers.

Only three of the six teachers that were interviewed reported that they used methods different from those in the *Step in New Primary Mathematics Grade 7* textbook to solve problems. However, their responses did not necessarily mean that they encouraged the learners to solve the problems in their own ways, but to choose from those shown to them.

The following were some of the teachers' responses:

Ms. Mbezo: *Sometimes the learners will not be understanding the method used in the textbook, so I use methods from other textbooks.*

Mr. Banga: *Yes, I do, when I am explaining some worked examples because in mathematics we do not have to say this is the only method of working out. The textbook has its own method, and I am used to my own method. I will first explain my own method and then the textbook method. I always ask the learners to choose the method they are most comfortable with.*

Mrs. Demo: *Some of the methods that are used for the worked examples are too difficult yet there are simpler methods to do the same sum.*

Interviewer: *Do you have an example of where a more difficult method was used in a worked out sum in the textbook?*

Mrs. Demo: *I would need to be looking at the textbook to answer that question. But in such cases I use my own method and leave the method in the textbook, so that the learners can better understand, but you come to the same answer. It is also a good thing if you can make the learners realise that there can be several methods to solve a given problem.*

Although the teachers' questionnaire responses said that they encouraged the learners to solve problems from the mathematics textbook in their own ways, there was no evidence of this happening in the lessons that the researcher observed. If anything, all that the learners were expected to do was to follow the method(s) in the examples that the teachers had worked out on the chalkboard. The teachers themselves did not indicate that it was possible to use more than one method to solve the problems at hand. This could be because the teachers felt it might confuse these young learners if they exposed them to more than one method at this stage. Also, the textbook does not show alternative methods for solving problems. This finding confirms the findings from earlier studies by Moulton (1994), Stringer (2008), and Susuwele-Banda (2005) that what the teachers said they do when responding to questions was not always what they do when they are observed teaching in the classroom. In fact, the lesson observations showed that the teachers tended to exaggerate the extent to which they promote the learners' autonomy in problem-solving strategies when they were asked in the questionnaires.

Some literature that was reviewed (Carr, 2006; Perso, 2006; Susuwele-Banda, 2005) encouraged the approach where the learners used their own strategies to problem-solving, as long as they can explain their methods, and as long as they arrived at the same correct answer. The ability of the learners to use different procedures or methods to solve a mathematical problem, but still arrive at the correct answer, is termed *procedural fluency* (Department of Basic Education, 2013a, p.8). It is strongly recommended that the learners are exposed to a variety of methods, or are encouraged to discover these methods as a way of enhancing their conceptual understanding of mathematics.

4.3.1.4 Homework

The teachers' responses on whether and how often they used the *Step in New Primary Mathematics Grade 7* textbook to assign homework to the learners and to set revision exercises or tests are discussed next.

Table 4.7: The frequency of the teachers' use of the textbook for homework and revision

Questions		Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q2	I assign homework from the textbook.	Respondents	31	17	22	5	3	3
		Percentage of responses	38%	21%	27%	6%	4%	4%
Q6	I use the revision exercises in the textbook.	Respondents	22	21	23	10	4	2
		Percentage of responses	27%	25%	28%	12%	5%	2%

As shown in Table 4.7, thirty-one (38%) teachers always assigned homework from the *Step in New Primary Mathematics Grade 7* textbook, 17 (21%) did so very frequently, while 22 (27%) occasionally assigned homework from the textbook. On the other hand, five (6%) teachers rarely used the textbook, three (4%) very rarely, and another three (4%) never used the textbook for homework.

The interview responses from the teachers who said they used the textbook to assign homework were as follows:

Ms. Mbezo: *I use the textbook especially for homework because it is handy, the learners can take it home and the homework sections are there in the textbook. Also, because of its worked examples, the parents or whoever stays with the child can use the*

textbook to help the child with homework.

Mrs. Gano: *because of the textbook layout on examples, it has made the teaching of mathematics go even beyond the classroom; children can do mathematics at home.*

Mrs. Demo: *...so we also use it to give homework. If parents want to help the child with homework, they can assist by studying the worked examples first. There are also homework sections in the textbook.*

Mr. Badza: *At times I give homework from the textbook, so that learners copy the questions into their notebooks in order to answer them at home. This is because the learners may not take the textbooks home.*

Of the six lessons that the researcher observed, two teachers gave homework from the homework sections of the textbook. One teacher (Mrs. Gano) told her class that the class work not completed during the lesson would become their homework. Another teacher (Ms. Pfumo), assigned homework from the *New Ventures in Mathematics*. She wrote the six questions on the chalkboard, and the learners had to copy them into their exercise books in the last five minutes of the lesson. In a post-lesson observation interview the researcher asked Ms. Pfumo as follows:

Interviewer: *Why did you give homework from the New Ventures in Mathematics, and not from the Step in New Primary Mathematics Grade 7?*

Ms. Pfumo: *The homework section in Step in New Primary Mathematics Grade 7 has only 3 questions on this topic, but in the textbook that I used there are 6 questions. So I want the learners to have more practice, plus they may not take these textbooks home.*

The questionnaire and interview responses and the lesson observations indicated that most of the teachers used the *Step in New Primary Mathematics Grade 7* textbook to assign homework. This is good practice, because homework tasks promote reading comprehension, and in some

learners' homes it could be the only book available to read. In addition, homework reinforces the work done during the lesson, and represents what Lee (2011) referred to as *the after-lesson textbook usage stage* (see section 2.3.4). Homework can even be set so that the learners could work on the concepts at home, before they are introduced in class. However, it can only work on condition that the parents are literate and numerate enough to be able to assist or monitor their children's homework.

A significant number of teachers (11 in total) rarely, very rarely or never used the *Step in New Primary Mathematics Grade 7* textbook to assign homework. This confirms some study findings (Chavez-Lopez, 2003; Lee, 2011; McNaught et al., 2010) that teachers do not rely on only one mathematics textbook, or that they add content from resources other than the core textbook.

Ms. Pfumo's concern with the number of questions in the homework section of the textbook was significant, in that it points to a shortcoming in the textbook, and also raises the question of how much mathematics homework should be given to grade 7 learners daily. There were generally too few questions in the homework sections of the textbook, a concern also expressed in the post-lesson observation interview with Mr. Badza, who had to add to the three homework questions on page 17 from another textbook. Ms. Pfumo's response, like Mrs. Demo's earlier, also indicated that school textbook policies on whether the learners are allowed to take the textbooks home or not, is a factor influencing how teachers use the mathematics textbooks. However, two positive attributes of this textbook were mentioned in the interviews, namely that there were clear, easy-to-follow completed examples, and there was a homework section after each exercise.

These matters are discussed later in this chapter, under research question 2.

4.3.1.5 The use of the textbook for revision exercises and tests

Teachers used the *Look back* and *Try again* sections in the textbook to gauge the computational and conceptual skills of the learners. These are revision exercises or tests that are presented in the textbook after every 5 or 6 topics. This transpired in the questionnaire and interview responses, as reported below.

On the same Table 4.7, for teachers using the textbook for revision exercises and tests, 22 (27%) teachers always did, 21 (25%) very frequently, 23 (28%) occasionally, ten (12%) rarely, four (5%) very rarely, and two (2%) never used the textbook to set revision exercises and tests.

When asked what they used the textbook for, three of the teachers gave the following answers:

Ms. Mbezo: *I also use it (the textbook) for test exercises, it has a number of revision exercises called Look backs.*

Mr. Badza: *It has some revision tasks after every 4 or 5 weeks which enhance the concepts covered.*

Mr. Banga: *I use the revision exercises that are in the textbook. Every Friday the learners write a revision test. Let us say we are covering area and perimeter, I select some questions from these different topics.*

Although the teachers' responses in the questionnaires and interviews mentioned using the mathematics textbook for revision tests, none of the lessons that the researcher observed was a revision test. This was because lesson observations had been deliberately slotted on days and times when the teachers were not giving tests. However, in the lessons that the researcher observed there was much evidence of the teachers using the textbook for individual class work, group work, and for setting homework for the learners. This, to a large extent, confirmed the veracity of questionnaire and interview responses.

4.3.1.6 Following the sequence of the textbook

Closed-ended question number 4 sought to establish whether the teachers were followers of the textbook or not. The results are displayed in Table 4.8.

Table 4.8: The teachers’ responses on whether or not they followed the sequence of the topics in the textbook.

	Question	Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q4	I follow the sequence of topics in the textbook.	Respondents	17	10	16	19	7	12
		Percentage of responses	21%	12%	20%	23%	9%	15%

Table 4.8 shows that 17 (21%) teachers always followed the textbook sequence of topics, 10 (12%) did so very frequently, 16 (20%) occasionally, 19 (23%) rarely, 7 (9%) very rarely, and 12 (15%) never did so.

Only three teachers gave explicit answers during the interviews on whether or not they followed the textbook topic sequence. Their responses were:

Ms. Pfumo: *I pick on relevant topics to teach, not following the topic sequence.*

Ms. Mbezo: *Chapters are not arranged in logical order, so I do not follow the textbook sequence.*

Mrs. Demo: *The topics are okay, but the order is not. For instance the topic ‘Money’ is in unit 20, but according to the syllabus it is just after Addition and Subtraction (units 3 and 4), and should be done in the first term. So I move it (the topic Money) to where it should be when I scheme and plan. I am just not happy with the movement backwards and forwards within the textbook: for example, “Turn to page 200” in one lesson, then in the next lesson “Turn to page 17”.*

It was not possible to tell from personal observation the extent to which the teachers followed the

sequence of the topics as they are presented in the textbook because the researcher only observed one lesson per teacher. If he had asked for the teachers' schemes of work and lesson plans (teacher document analysis) he would have been able to verify their interview and questionnaire responses on this question. However, it is important to take note of earlier research findings reported by Jamieson-Proctor and Byrne (2008) which characterised teachers who followed the sequence of the textbook topics as *traditionalist*, and those who did not as *constructivist* (see section 2.5). The 17 (21%) teachers (in Table 4.8) who always followed the textbook sequence would fall in Lee's (2011) description of teachers with a closed perspective, who also viewed the textbook as error-free and as an absolute authority.

4.3.1.7 Developing the correct mathematical language and using real life examples

The terminology used in parts of the mathematics textbook required from the teachers to explain and clarify it for the benefit of the learners. The teachers could make use of real life examples from the social or cultural backgrounds of the learners to explain these textbook concepts. Closed-ended questions 7 and 10 asked the teachers to indicate the extent to which they used these strategies in their teaching, as reported below.

Table 4.9: Summary of the teachers’ responses on using the textbook to develop the learners’ mathematical language, and using the learners’ backgrounds in explaining textbook concepts.

Questions		Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q10	I use the textbook to develop the learners’ correct mathematical language	Respondents	23	22	22	5	6	3
		Percentage of responses	28%	27%	27%	6%	7%	4%
Q7	I explain the concepts in the textbook using examples from the learners’ background.	Respondents	44	16	12	6	4	0
		Percentage of respondents	54%	20%	14%	7%	5%	0%

Table 4.9 shows that 23 (28%) teachers always used the textbook to help develop the learners’ correct mathematical language, 22 (27%) did the same very frequently, and another 22 (27%) occasionally did so. On the other hand, five (6%) teachers said they rarely, six (7%) very rarely and three (4%) never used the textbook to develop the correct mathematical language of the learners.

In the lesson observations Ms.Mbezo indicated to the learners that $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{5}{10}$, and that these are called *equivalent fractions*, meaning that they are the same or equal in value. Also, Ms. Pfumo explained *discount* as the amount of money that is deducted from the sale price of an article when a customer pays cash.

The same Table 4.9 also shows the teachers’ responses to closed-ended question 7 on explaining textbook concepts, using examples from the learners’ background. More than half the

respondents, or 44 (54%) teachers, indicated that they always used examples from the learners' background to explain some textbook concepts. On the same aspect, 16 (20%) of the teachers' responses were that they did so very frequently, and 12 (14%) did the same occasionally. At the other extreme, the responses were six (7%) rarely, and four (5%) very rarely. There were no respondents who gave the 'never' response. Although this category represents a small number of teachers, it is a cause for concern that they did not use examples that the learners were familiar with. This is because nowadays it is widely accepted that mathematics should be taught in context in order to bring real life situations into the classrooms "by applying mathematics to social, environmental, cultural and economic contexts" (Department of Basic Education, 2013b, p.5).

It is clear from these responses that the majority of the teachers always drew on the learners' background experiences when explaining the concepts in the textbook. This position was confirmed in both the teacher interviews and the lesson observations, as reported in the next section.

The three teachers that the researcher interviewed on their use of examples from the background of the learners said:

Ms. Pfumo: *For example on Volume, I use a bucket and half fill it with water, then I put a brick inside in order to demonstrate displacement. This helps those learners who have problems in understanding "What volume is displaced?" They see and experience these things at home.*

Mrs. Demo: *When I am teaching fractions I sometimes bring a bar of soap and show the learners how to get $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, from one whole.*

Ms. Mbezo: *We would require training in textbook use to include mathematical language.*

The matter of the teachers' professional development is discussed in detail under research question 2.

Although the majority of the questionnaire respondents (54% altogether) said they used examples from the learners' background when explaining textbook concepts, there was confirmation of this practice in only three of the six lesson observations.

Three teachers– Ms. Pfumo, Mrs. Gano and Mr. Banga- made clear links between the topics in the mathematics textbook and real life objects, practices or natural phenomena. Mrs. Gano brought 3-dimensional shapes to the classroom and also made important links between the work in the textbook on 3-D shapes and other learning areas, namely by referring the learners to the pyramids of Egypt. She also used the textbook ideas to take the learners out of the classroom to view 3-D shapes in the form of the school classroom block. Mr. Banga's reference to the earth's rotation was an extension of the textbook work on the conversion of time, and also linked to Environmental and Natural Science. This practice helped the learners to understand the concepts better and, as Nickson (2001) argued, they could link the mathematics they meet at school with what they already experienced in their natural and social environment. Thus it fulfilled the expectation to teach in context, by not confining mathematics to the four walls of the classroom. Ms. Pfumo referred the learners to the picture of Zama Zama Outfitters in the textbook (page 157) when discussing discounts on short, long-sleeved shirts and blouses.

Incidentally, Ms. Pfumo and Mrs. Gano were among the more qualified and experienced teachers in this study, since they both held a Bachelor's Degree in Education in addition to the certificate/diploma in education (see Table 3.3). It would appear that the better qualified the teachers are, the more they were willing and able to draw on ideas beyond the prescribed textbook content. This, to some extent, reflects a 'rich' teacher's subject content knowledge which, according to Hoadley & Jansen (2009, p.108), "enables a teacher to enrich the learning process with a broad range of illustrations, and to integrate prescribed content with the wider world, the learners' lives, and other learning areas."

- **General trends in the lessons observed**

The general pattern in most of these lessons tended to adopt the sequence described below:

Phase 1: The teacher worked out a problem taken from the textbook on the chalkboard.



Phase 2: One or two learners were invited to the front to work out a problem taken from the textbook on the chalkboard.



Phase 3: Pair work or group work, where the learners worked out set questions from the textbook. They reported back their solutions to the whole class afterwards.



Phase 4: Individual class work, taken from the textbook, with the teacher monitoring learners' progress.



Phase 5: The teacher gave homework, also from the textbook.

In the introductory phase the teacher would refer the class to the relevant textbook page, and read or ask one of the learners to read out the question aloud as he/she wrote it on the chalkboard. The teacher would then work out the steps involved in solving the problem, and engage the learners by means of questions and answers (see lesson observations in section 4.3.1.1). In the end, when the answer was obtained, the teacher would ask if all the learners had followed the procedure, or if any learner had a question. Mostly the learners would not have any questions and would say they had followed the teacher. This teacher exposition method is a necessary procedure, especially for this level of learners, because you cannot simply leave them to discover the methods of solving problems on their own, as some constructivists suggest. In actual fact, critics of constructivism (Kirschner et al., 2006; Mayer, 2004) insist that teacher exposition, using completed examples would benefit young learners of mathematics.

The second phase mostly involved asking one or two learners to come to the front and work out a

problem from the relevant textbook and exercise on the chalkboard. These learners were encouraged to explain every step as they solved the problems, and could involve the rest of the class in working out the answer. The teacher monitored the accuracy of the work, and also kept an eye on the class to make sure they were paying attention.

The lesson observations confirmed what the majority of the teachers said in the interviews and questionnaire responses to closed-ended question 1, namely that they used the mathematics textbook daily and as the core textbook. The teachers used the textbook as the main source of completed examples, which they copied onto the chalkboard and explained to the learners. This approach to the use of the textbook was recommended by Antony & Walshaw (2009) as good and effective practice, because the teacher initially took the learners through the stages in solving exemplar problems before asking them to solve more difficult problems from the textbook. In support of the teacher-led explanations in solving problems, Carr (2006) said that a concept needed to be fully developed orally before the learners could be asked to do written work, so that they may be able to use the correct symbols and mathematical expressions. This stage of textbook use helped the learners to appreciate that in problem-solving the process that led to the final answer was just as important, if not more important, than merely giving the answer.

4.3.1.8 Exceptions to the general trends observed in the lessons

There were some teachers who handled parts of their lessons a little differently from the general trend described above. Two of these exceptions are discussed briefly next.

- **The use of pictures/diagrams in the mathematics textbook to develop concepts**

One teacher, Ms. Pfumo, spent time looking at the picture of Zama Zama Outfitters on page 157 in the textbook together with the learners, and asking them a variety of questions, based on the picture. Both low and high order questions were asked, as listed here:

- Who are Zama Zama Outfitters?
- What goods are on sale?

- What is a short-sleeved shirt? A long-sleeved shirt?
- What percentage discount is being offered? On which products?
- What is *discount*?
- When and why do shops give discount?
- In what ways do shop owners benefit from offering discounts?
- How do the customers benefit from receiving discounts?

As can be seen from this list, both low and high order questions were asked. This manner of questioning is good, and consistent with that advocated in Bloom's taxonomy of educational objectives (Lawton, 1982; Stenhouse, 1979).

Even after doing a question on discount, Ms. Pfumo continued to interpret the answer in terms of how much the actual discount was, how much the customer would finally pay, and how much the customer would save (see Ms. Pfumo's lesson summary in section 4.3.1.1). This approach helped the learners to understand the underlying reasons for offering discounts, as it went beyond the purely mechanical process of working out an answer. Ms. Pfumo also wanted each group's answer to be written on the chalkboard, and gave the class homework from a source other than the *Step in New Primary Mathematics grade 7* textbook.

- **Lost opportunities**

In describing Eisner's (2003) connoisseurship evaluation model, Ornstein & Hunkins (2004) highlighted that an evaluator who follows Eisner's model would have to rely on personal observations, and take note of the actions of both the teachers and the learners. There were instances in the lessons that the researcher observed where the teachers failed to extend the textbook examples or content for the benefit of the learners, and the researcher termed them 'lost opportunities'.

The three teachers' lessons described below are examples of where 'lost opportunities' were observed.

1. Mr. Badza

Firstly, the two examples on addition of 4-digit numbers with 'carrying' that the teacher used on the chalkboard, taken from page 17 of the *Step in New Primary Mathematics Grade 7* textbook and those given for group work all involved carrying '1' all the time. The teacher could have created other 4-digit addition questions where the addition would result in carrying digits bigger than one. Secondly, the same teacher read out aloud the answers of the additions that he had worked out on the chalkboard, instead of asking one of the learners to do so, as a way of checking or testing their ability to read 4-digit numbers.

2. Ms. Pfumo

Question 4(b) on page 157 of the textbook asked learners to work out the percentage decrease from 75 to 70. The learner who worked it out on the chalkboard obtained an answer of $\frac{20}{3}$ which she finally gave as 6,66%. Ms. Pfumo accepted this answer without any comment about rounding off to the 1st, 2nd or 3rd decimal; or about recurring decimal numbers. The textbook question was also silent on whether the answers should be rounded off to the 2nd decimal or not. Alternatively, this teacher could have shown the learners that $6\frac{2}{3}\%$ is also an acceptable answer to this question.

3. Mrs. Demo

The teacher wrote this question on the addition of mixed numbers from page 69 of the textbook on the chalkboard: $2\frac{1}{8} + 1\frac{5}{12}$. When the calculation reached the stage of $3\frac{3}{24} + \frac{10}{24}$, one learner was asked to simplify, and she wrote the answer as $\frac{16}{24}$. Instead of explaining to the learner why her answer was incorrect, the teacher simply asked another learner to come and write the correct answer, and this time the correct answer of $3\frac{13}{24}$ was given. There were no further comments from either the teacher or the learners concerning the wrong answer or the correct answer. The teacher simply switched to group work. Santos et al. (2006) described this teacher practice as being only interested in checking if the answer was right or wrong, with no

process analysis. This was another *lost opportunity* to deal with learners' misconceptions, and for the teacher to learn about the child's thought processes leading to this incorrect answer. Mrs. Demo should ideally have interviewed the learner who added a whole number to the numerators in order to understand her thought process. By doing so, the teacher would have gained insight into how and why this learner arrived at $\frac{16}{24}$ instead of $3\frac{13}{24}$. One benefit of this answer analysis is that it makes the teacher think of alternative teaching strategies and techniques that would enhance conceptual understanding. Another benefit is that it could serve as teacher development, since the teachers get to understand how and why learners think in certain ways.

4.3.1.9 Conclusion to research question 1

The foregoing account on research question 1 has revealed that teachers used the *Step in New Primary Mathematics Grade 7* textbook in a variety of ways. Most teachers used the textbook's completed examples when explaining new concepts on the chalkboard. At times some learners were asked to solve problems from the textbook on the board. The textbook was used in whole-class discussion, small group or pair work, individual class work, homework and for revision tests. All these were good approaches to textbook use as they promote interaction through the reading of the text and discussion. Also, some teachers expanded and simplified the language, used real life examples, and restructured the sequence of the textbook topics. However, there were instances where some teachers did not exploit fully the content of the textbook nor did they make up for the textbook's shortcomings. There were also instances where the teachers' questionnaire and interview responses were at variance with what was observed in the lessons.

4.3.2 Research question 2:

What factors influence how the grade 7 teachers use the mathematics textbooks?

The responses from the open-ended items on the questionnaires and interviews were generally the same, and they revealed some strengths and challenges, or weaknesses which influenced how the teachers used the *Step in New Primary Mathematics Grade 7* textbook. The researcher found it convenient to classify these challenges into four categories, namely textbook-related, learner-related, policy-related and teacher-related factors, as listed and discussed below.

4.3.2.1 Textbook-related factors

The textbook-related factors fell into two broad groups, namely the strengths and the weaknesses, or the challenges.

- **The strengths of the textbook**

These are the positive attributes that influence the teachers (and learners) to use the textbook.

Two frequently mentioned strengths by the questionnaire respondents to open-ended question 5 were the clear worked out examples and the *Look back, Try again* and homework sections.

- The worked out examples were often used by the teachers when explaining concepts on the chalkboard and the learners could also refer to them when working on their own, or when their parents helped with the homework.
- There were *Look back* and *Try again* sections after every 4 or 5 chapters of this mathematics textbook, and these helped to test the learners on how much they had grasped in those chapters.

Interestingly, two questionnaire respondents stated that there were no strengths in this textbook.

Unfortunately there was no way of finding out from these teachers why they gave this response. The teachers who were interviewed were satisfied that the *Step in New Primary Mathematics Grade 7* textbook covered the grade 7 mathematics syllabus adequately. There were many exercises on each topic and this helped the learners in having sufficient practice, and practice makes perfect. The clearly worked out examples and the illustrations or diagrams assisted the learners even when they were working on their own. The well thought-out homework sections on each topic made life easy for the teachers. The majority of the respondents felt the language in the textbook was appropriate, and it helped to enrich the learners' mathematical vocabulary. In support of this view one respondent said,

Ms. Mbezo: *For example on addition, the textbook uses the terms 'increase', 'add', 'count on', 'the sum of', 'the total number', 'how many altogether'.*

The other strengths that were mentioned by the respondents were:

Ms. Pfumo: *Key concepts are highlighted.*

Ms. Mbezo and Mrs. Demo: *It caters for both slow and fast learners.*

Mr. Badza: *All expected mathematical concepts in the syllabus are adequately covered.*

Mrs. Gano: *The binding of the book is strong, hence a guarantee for long book life.*

- **The challenges and weaknesses of the textbook**

It seemed that the textbook language was a contentious issue, with some teachers indicating that it was easy to understand by grade 7 learners, yet many also stated that they simplified the language used in the textbook. Closed-ended questions 8 and 9 addressed this language issue, and the results are shown in Table 4.10.

Table 4.10: The extent of textbook language difficulty, and whether the teachers simplify the textbook language.

Question		Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q.8	The language used in the textbook was easy for grade 7 learners to understand.	Respondents	21	19	31	3	6	2
		Percentage of responses	25%	23%	38%	4%	7%	2%
Q.9	I simplify the language used in the textbook.	Respondents	24	21	22	9	3	3
		Percentage of responses	29%	25%	27%	11%	4%	4%

The teachers' responses to closed-ended question 8 shown in Table 4.10 revealed that most of them agreed that the language used in the mathematics textbook was easy for grade 7 learners to understand. This was supported by 21(25%) teachers whose response was 'always', 19 (23%) teachers' response was 'very frequently' and 31 (38%) teachers viewed the textbook language as occasionally easy for the learners to understand. Apparently the rural learners faced greater language and contextual challenges than their urban counterparts. This was because a significant number of the rural questionnaire respondents fell in the 'rarely' (9, or 11%), 'very rarely' (3, or 4%), or 'never' (3, or 4%) categories. Most of the rural environments were not well stocked with reading resources that the grade 7 learners could access. This was compounded by the relatively low literacy levels of the rural parents, as stated by Hoadley and Jansen (2009).

On the same Table, 4.10, and in response to closed-ended question 9, a total of 24 (29%) teachers pointed out that they 'always', 21 (25%) 'very frequently', and 22 (27%) 'occasionally' simplified the language that was used in the textbook. This was good practice because in any textbook there are likely

to be some terms that require simplification. On the other hand, three (4%) of the respondents never simplified the language in the textbook, another three(4%) very rarely, and nine (11%) rarely simplified the textbook language, presumably because they thought the learners found it easy to follow. Failure to understand the textbook language may result in the learners’ incorrect interpretation of the demands of the questions. The apparent contradiction in the teachers’ responses to closed-ended questions 8 and 9 may lie in the varied school environments.

The context of some questions was frequently mentioned by the interview respondents as not accessible to most of the learners. Closed-ended question 5 sought the teachers’ opinion on this matter, and the results are presented in the table below.

Table 4.11: Do the teachers feel that the textbook uses examples that the learners are familiar with?

Q.5	Question	Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
	The textbook uses examples that the learners are familiar with.	Respondents	16	21	30	10	4	1
		Percentage of responses	20%	25%	37%	12%	5%	1%

Table 4.11 shows that 16 (20%) teachers agreed that the textbook always used familiar examples, and 21 (25%) said it very frequently did so. Thirty (37%) teachers indicated that the textbook occasionally used examples that the learners were familiar with, ten (12%) indicated ‘rarely’, four (5%) ‘very rarely’, and one (1%) ‘never’. These responses indicated that some learners could truly be experiencing difficulty in understanding the textbook examples. The following teacher interview responses are further proof of this problem.

Mrs. Gano: *Some of the content in the textbook is very difficult.*

Mrs. Demo: *The learners are not familiar with most of the contexts used in the questions because of their rural backgrounds, so I have to do a lot of explaining.*

Mr. Badza: *At times the exercises are too challenging. The first topic on numbers, it just starts with millions and thousands. These are very big numbers, and they should be scaled down.*

The textbook questions listed below are examples of questions that were identified as difficult in the teacher interviews, especially for the rural learners.

- Page 21, question 1 (homework section): The turnover for a company was \$111437,00 for the first six months of one financial year.....
- Page 123, question 3: Standard eggs are sold at \$1 each, but pullet eggs cost only 80c each. What is the total cost of 20 standard eggs and 20 pullet eggs?
- Page 154, question 2: The handyman has painted two thirds of a house.....
- Page 160, question 2: An estate agency charges 15% commission for his services. How much will it earn if the block of flats it administers brings in \$60000 rentals?
- Page 174, question 7: For a drama festival a school hires a theatre at \$4000 a night for 3 nights.....

Interviewer: *In what ways do you deal with such difficulties in the textbook?*

The teachers' responses:

In each of these questions the teacher has to spend time explaining the terms used, since they are novel to most of the learners. For example, what is a standard egg, and how is it different from a pullet egg? What or who is a handyman? What is an estate agency, a block of flats, to administer? What is a drama festival, a theatre? What is turnover, a financial year? There is an added problem in the question on the estate agency, because it gives the impression that an agency is a person and not an institution!

Sometimes the teachers had to explain the meaning of the number story first, leaving out the

mathematical concept in it, in order for the learners to understand. In many cases the teachers had to explain in Shona first, and refer to examples from the learners' home environments so that they could understand.

When taken together, the responses to closed-ended questions 8 and 9 pointed to the fact that the textbook definitely has areas where the language was difficult for the learners, and had to be simplified in order for them to understand. In part this stemmed from the peculiarity of the mathematical language, and also from the context in which a mathematical problem may be situated. Another factor which contributed to the language problem was that English is a second language for the learners, and so the learners did not always comprehend the questioning. Therefore it is an important task for teachers to help develop the mathematical language of the learners (Antony & Walshaw, 2009; Carr, 2006; Turuk, 2008). In particular, Turuk emphasised the important role of language as a socio-cultural tool which can help learners to comprehend mathematical concepts.

The researcher found that some teachers did not only simplify the language used in the mathematics textbook, but they also sometimes switched to the vernacular (Shona in this case) language in order to explain some concepts in a way that the learners could understand. This was confirmed in the questionnaire and interview responses, as well as in the lessons observed (see lessons by Ms Mbezo and Ms Pfumo above). These teachers explained and gave examples in Shona, then reverted to English and explained the same concepts in English as well. The simplification and explanation of mathematical terminology in part enabled the connection-making process that Vygotsky (1978) described as *scaffolding*. It is this process of scaffolding that helps to develop the meanings of mathematical concepts. Mathematical language can be very intricate to some learners because it makes use of peculiar symbols and terms. Therefore language simplification and/or switching can be an important strategy to help the learners understand better, and develop in them an appropriate mathematical vocabulary.

Obara and Sloan (2009, p.359) agreed that it is good practice to simplify the language used in the mathematics textbook, and also to make the learners read out aloud passages or questions from the textbook. The latter practice helps the teachers to identify the learners' reading difficulties. In the lesson observation and post-lesson interview with Mr. Banga (see section 4.3.1.1) it was quite evident

that some learners did have reading problems. Invariably, if learners cannot read it also means they do not understand how to do the class exercises and homework, leading to poor mastery of mathematical concepts. This point was expressed quite clearly by Nyanchoka, one of the participant teachers in the study by Obara and Sloan when she noted that: “If I do the reading for them and try to explain what the word problem is asking, then they have no problem with it, and they understand it, and they are okay with it” (p.359).

The other textbook-related factors that the respondents mentioned in the open-ended questionnaire were, namely that:

- Not every learner has a textbook. This is partly due to thefts, but also because textbooks were allocated to schools at 40 copies per class (the official class size in Zimbabwean primary schools). In reality some classes have more than 40 learners, hence the shortfall. This results in some textbook sharing (though on a limited scale), and its related problems, as was discussed in chapter 1 (see section 1.1).
- There were no sample questions of the end-of-year paper 2 examination, and the teachers had to improvise. Paper 2 requires from the candidates to show all the steps when solving problems.
- The respondents were unhappy with what they called ‘too big numbers for the level of the learners’. By this they meant the numbers that are in thousands and millions in the first chapter of the *Step in New Primary Mathematics Grade 7* textbook on numeration and notation. This concern is surprising, given that the primary school syllabus of the Ministry of Education, Sport, Art and Culture expects the learners to “say, read, and write in numerals or words, give a position or name, any number in the range 0 to 1000000” (Logan & Tambara, 2010b, p.177). Therefore, whether it is the current textbook or the previous ones, the fact remains that these numbers are part of the official syllabus and have to be taught to the learners.
- Some respondents expressed concern with the sequencing of topics in the mathematics

textbook (see Mrs. Demo's comment in section 4.3.1.6). The teachers expect the mathematics topics in this textbook to be arranged as in the syllabus topic sequence in order to avoid too much reference back and forth in the textbook. This expectation is reminiscent of the order in which the early textbooks were written (Johansson, 2006). Then, the mathematics textbooks authored by Robert Record were written with the topics ordered in the sequence they were supposed to be taught (see section 2.1). While the topic sequence of this textbook may pose problems in planning for a newly-qualified or unqualified teacher, it should hardly be a problem for experienced teachers to re-shuffle the topics as seems fit.

- Two respondents were worried that there was too much content in the textbook that had to be covered each week. This, however, was hardly a valid concern, and should, in fact, be viewed as a strength, since the teachers have more exercises to choose from. The main idea was not to always expect from the learners to do all the pages or exercises in the mathematics textbook, as Van de Walle (2007) cautions, and what Remillard (2005, p.220) described as the teachers' pre-occupation with "covering the textbook".

The interviewees identified several challenges that this textbook has, which were not mentioned in the questionnaires. These challenges are listed below in the exact words of the respondents.

- The textbook should include more pictures in order to cater for non-readers.
- The language used in some number stories is not easy to understand.
- Some methods used are too difficult for the learners to grasp, when there are actually easy ways known of solving the same problems.
- Occasionally you meet textual errors and wrong answers in the textbook.

Regarding the fact that in some cases the methods used for the completed examples are too difficult for the learners, yet there are simpler methods that can be used to do the same sums, the two teachers who mentioned this in the interviews failed to give specific examples of such methods when they were asked to do so.

In respect of the end of year tests given in this textbook, the interviewed teachers suggested that, in the event of a revised edition of this textbook, the setting style should resemble the Zimsec style for Sections A and B, so that the learners can practise using this textbook. The inclusion of more typical examination questions at the end of each chapter, and the use of simple mathematical language were also suggested. Also, they would like to see more Paper 2-type questions in the section on revision tests.

Concern was expressed that some word problems were either unclear or are wrongly stated, and some answers to exercises in the textbook were incorrect (see the next section for an analysis of some of the errors in the textbook). These are matters of textbook quality, as reported earlier in the literature reviewed. For example, Ying & Young (2007) commented on the need for textbooks that are complete and comprehensive. In addition, Lee (2011, p.3) observed that “if the textbook is a necessary resource for teaching activities in the classroom, we should make good textbooks first”. The interviewees pointed out that they had to work out the answers to all the exercises in the textbook because some of the answers given in the Teachers’ Book were incorrect. This was good practice because the fact that the answers were provided should not absolve the teachers from their responsibility to check that the answers were correct. By so doing the teacher can get an idea of the challenges the learners may be experiencing.

Errors identified in an analysis of sections of the textbook

- Page 150. Homework question 1:
- The surface of a reservoir has an area of 600m^2 the depth of water is 2m. (a) Given that the mass of water is 1000kg per cubic metre, and that 1 tonne = 1000kg. Find the mass of water in tonnes.

Comment: There is wrong punctuation in this question.

- Page 152. Section A: Percentages:

Each square has been divided into 100 small squares. In A, 80 squares are shaded. We say $\frac{80}{100}$ or 0% of the squares are shaded.....

Comment: It should be 80% and not 0%!

- Page 164. Homework section, question 2:

A picture of an area of $\frac{1}{6}\text{m}^3$ The mounting's area of $\frac{1}{3}\text{m}^3$. What is the ratio of the area of the picture to the area of the mounting?

Comment: Something is missing after $\frac{1}{6}\text{m}^3$, plus units of area are expressed in m^2 , not m^3 .

- Page 171. Question 2:

A recipe for small cakes requires $8\frac{2}{9}\text{kg}$ of sugar and $6\frac{1}{3}\text{kg}$ of flour.

(b) Express the ratio of the sugar to the flower as a fraction.

Comment: Different spellings for one product: flour!

- Page 174. Looking Back 3: Section D. Question 2:

A dealer bought 50 items \$3500 at an auction for. He sold them for \$65 each. What percentage profit or loss did he make?

Comment: Some words in the first statement of this word problem are misplaced.

- Page 208. Homework:

The second question 1 is misplaced. It belongs to Section E on the Sports League information on page 209, and not to the bus timetable in Section D.

- Page 218. Question 5(a) (ii) 'vertica' instead of 'vertical'.

In some instances the prices used in this textbook are unrealistically high, given that the country makes use of United States of America dollars. Examples of these prices are:

1. Page 38, homework section. Question 2(b). How much did the trip cost if petrol is \$30 per litre?
2. Page 47. Question 8: If each 2l bottle of milk costs \$23.....
3. Page 52. Question 5: 4 bicycles cost \$12246 altogether.....
4. Page 52. Question 8: A 4-wheel drive costs \$378000, and a Mazda 323 hatch back \$275260.....

These prices were reasonable when the Zimbabwean dollar was still in use and there was a high inflation rate in the country, but since 2009 the US dollar has been adopted, thus making it necessary to make adjustments to these prices.

In addition to unrealistic prices, some of the questions should be stated clearer. Examples of questions requiring clarity are:

- Page 162. Question 5: The price of cooking oil is increased from \$22.50 a bottle to \$35.00.

Comment: Instead of ‘bottle’, reference should be made a 750ml container, because cooking oil is not always packed and sold in bottles.

- Page 221. Section E: question 1(d): If the tank holds 4l of fuel, after how many km will the driver have to stop for more fuel?

Comment: This is a vague question. The driver does not wait until the tank is empty, because there may be no service station at that point. A careful driver will top-up before he/she runs dry!

4.3.2.2Learner-related factors

The open-ended questionnaire and interview responses were generally the same, and were summarised as follows.

- Most learners are below average ability, and thus cannot comprehend the text.
- The learners are frequently absent from school, so they lack continuity of mathematical concept development. For example, at one rural school 5 out of 43 learners were absent on the day that the researcher observed the mathematics lesson. They were said to be assisting their parents with weeding and tobacco harvesting chores.
- Some learners do not get any help with their mathematics work at home because of their backgrounds. Their parents could be illiterate or the learners come from child-headed families.

These circumstances affect the prior knowledge and proficiency levels of the learners in mathematics. The teacher is therefore ‘forced’ to spend more time explaining the textbook concepts. As a result, teaching becomes more textbook and teacher-centred rather than being learner-centred, as advocated by Shafiuddin (2010) who said:

No lesson can be effective unless there is effective learner participation in it. In order to enable the learners to participate in the instructional process, there is an imperative need to adopt some kind of learner-centred approaches in the classroom (Department of Basic Education, 2013b, p.14).

Giving learners of this calibre, group work does not always yield good results because they cannot interpret the questions correctly, and so are likely to give incorrect answers.

4.3.2.3 Policy-related factors

The following factors were mentioned by the teachers.

➤ **School textbook policies.**

In some schools the learners could not take the textbooks home, and the textbooks were only used by the learners until the time school ends for the day. They were then locked up in classroom cupboards for safe-keeping. One disturbing finding in this study was that most of the rural and peri-urban schools did not allow the learners to take the mathematics textbooks home like in the urban schools, yet it was these learners whose environments were often deprived of reading material. Also, the practice of collecting and issuing the textbooks in daily mathematics lessons had the cumulative effect of losing many hours of teaching and learning time in a term or year. This is bound to affect the use of the textbooks as the teachers and the learners spend less time using the textbooks in each lesson. This is not only time-consuming in terms of the daily issuing and collecting of the textbooks, but it also meant if the teachers wanted to give their learners some mathematics work to do after school, the learners had to copy the questions from the textbook, something which is time-consuming, and may result in the learners copying wrongly from the textbook. The school policy that learners do not take textbooks with them home may have emerged from imperatives that are more compelling than the academic consideration to the school administration.

If the learners could take the textbooks home, it would be easy for the teachers to assign homework, and easy even for the learners to follow the worked out examples when working at

home, or for their parents to assist with the homework. Jansen (2013) emphasised the importance of the parents as a learning resource, and the fact that they should check that their children's homework is done on a daily basis, and for them to provide assistance wherever necessary. Therefore, in order for the literate parents to perform this important role, it is important that the learners are allowed to take their mathematics textbooks home. In support of policies that allow textbooks to be taken home, Askew et al., (2010) found that learners in high-performing countries are more likely to use their mathematics textbooks at home.

- Composite classes (see section 4.3.1.1, Mrs Demo's lesson)

One rural teacher identified the existence of composite classes at her school as a policy factor that influenced her use of the mathematics textbook. In addition she expressed concern that the majority of the parents there were illiterate and so could not give much assistance in respect of their children's homework. Also, once the learners were allowed to take the textbooks home they would not return them, or deface them. English is a second language, and also the official language of learning and instruction, and it is difficult for the rural learners to understand it.

The literature that the researcher reviewed indicated that there was no agreed optimum size for composite classes. However, in countries where composite classes exist, such as in Australia and Scotland, they are characterised by small class sizes. For instance, in Scottish primary schools the composite class size "is 20,6 pupils compared to 24,4 pupils in single-age classes" (Wilson, 2003, p.v). In contrast, the primary school that participated in this study consisted of a grade 6 and 7 composite class of 48 learners, which is more than double the official class size. Although the official class size in Zimbabwean primary schools is 40 learners, many schools are under pressure to enrol up to 50 learners per class (see section 3.6.1). By their very nature these classes were regarded as more difficult to teach, and added to the teachers' workload. Studies reported by Wilson (2003) indicated that the success of composite classes rests on the provision of extra resources, including time, specially trained teachers and parent support. Yet, the only resource that was evident in sufficient numbers at the primary school in this study was the *Step in New Primary Mathematics Grade 7* textbook. Therefore the teacher's use of this textbook could have been better if the other conditions were conducive, namely small class size, parental support, and

specific training on how to teach effectively in composite classes.

➤ Time

Limited time allocated for mathematics on the timetable affects the quality of textbook use because the teachers try to cover many concepts in a short space of time, thus giving superficial coverage to important work.

➤ Double-sessioning

The urban teacher interviewees mentioned ‘double-sessioning’ (or ‘hot-sitting’) at their schools as a problem, because some lessons had to be conducted outside the classrooms, especially during the transition from the morning to the afternoon sessions. Much time is often lost during this transitional period.

➤ Interference from other school activities

Concern was also expressed regarding school activities which interfere with teaching, such as sports, general work and unannounced meetings that teachers are required to attend at short notice – sometimes away from the school. One teacher (Ms. Pfumo) gave an example of a Performance Lag Assessment Programme (PLAP) meeting that she was required to attend for three days early in the first term of 2013. The implementation of this PLAP at school level is also very demanding in terms of the teachers’ time. These policy-related factors are close to those identified in a study by Ogbonnaya (2011, p.27), and were labelled as ‘school system’ factors. Ogbonnaya identified the provision of teaching resources, the curriculum, the time allocated for teaching, and conditions within the school as factors affecting the teachers’ teaching effectiveness. These findings are also consistent with those reported by Haggarty and Pepin (2004) in German, English and French schools (see section 2.4), where the lack of time due to the many responsibilities of the teacher inhibits thorough lesson preparation, and encourages teachers to be textbook followers.

4.3.2.4 Teacher-related factors

The two teacher-related factors that stood out clearly in this study were the levels of teacher confidence and the regularity of professional development workshops or in-service training.

- **The levels of the teachers’ confidence to teach all the mathematics topics in the textbook**

Closed-ended question 13 required from the teachers to indicate their level of confidence to teach all the topics in the *Step in New Primary Mathematics Grade 7* textbook.

Table 4.12: The confidence levels of the teachers to teach all the topics in the *Step in New Primary Mathematics Grade 7* textbook.

	Question	Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q. 13	I am confident to teach all the topics in this textbook	Respondents	14	19	22	8	9	10
		Percentage of responses	17%	23%	27%	10%	11%	12%

Table 4.12 shows that 14(17%) teachers were always confident, and 19 (23%) were very frequently confident to teach all the topics in this textbook. The largest group of teachers, 22 (27%) were ‘occasionally confident’ in using the textbook to teach all the topics. On the other extreme, as many as nine (11%) and ten (12%) teachers respectively were ‘very rarely’ or ‘never’ confident to teach all the topics using this textbook. This adds up to 19 (23%) cumulatively, and is too large a proportion of the total population to be ignored. Conducting regular professional development workshops could go a long way in restoring or boosting these teachers’ confidence. The lack of confidence with some mathematics topics is likely to result in its (the textbook) avoidance, or partial or superficial coverage when it comes to teaching these topics to the learners, and therefore translates into less effective ways of using the textbook. In

support of this view, Santos et al. (2006, p.801) said, “Often there are activities they have to skip because the teacher does not understand”. The end result is that the learners will lose out on some important concepts. Low teacher confidence may also result in the teachers engaging learners in what Stein and Kaufman (2010) described as ‘low quality tasks’ (see section 2.3.3), which revolve around routine procedures, and do not challenge the learners to generate their own strategies for solving mathematics problems.

Interestingly, all the six teachers who were interviewed felt confident in teaching all the textbook topics, and indeed, this teacher confidence was evident in all the lessons that were observed. This confidence was premised on their relatively long years of teaching experience, and on what some respondents described as the clarity of the worked-out examples in the textbook. They even felt so confident that, once they covered the textbook content, their learners should do well in the end-of-year final examinations. This is what one teacher said:

Mr. Badza: *Sure, sure, I do not have problems with any of the topics. Remember that I have 16 years of teaching experience.*

The aspect of teacher confidence was addressed by Collopy (2003) in relation to the use of textbooks by two experienced primary school teachers. As reported earlier in chapter 2, Collopy found that the confident teacher used the new mathematics textbook, omitted some activities suggested in the textbook, but supplemented it with other relevant work (see section 2.5). This finding is similar to what I observed in Ms. Pfumo’s lesson, where she used the *Step in New Primary Mathematics Grade 7* textbook in creative ways, but also used work from another textbook.

The better qualified teachers (those with a Bachelor of Education degree) were more willing and able to draw on ideas beyond those in the prescribed mathematics textbook. Also, in the lessons observed there were instances where the teachers failed to extend the textbook examples for the benefit of the learners-labelled ‘lost opportunities’ in this study- such as failure to interrogate learners on how they arrived at some (wrong) answers (see section 4.3.1.8). It is important that the teachers follow up on the learners’ incorrect answers so that they may be able to identify the

strengths and weaknesses in their own teaching approaches.

▪ **The regularity of the teachers’ professional development workshops**

Few professional development workshops on how to use mathematics textbooks in teaching are conducted in the Mashonaland East Province, as shown by the teachers’ responses to closed-ended question 14.

Table 4.13: How often are professional development workshops on the use of mathematics textbooks held in Mashonaland East Province?

	Question	Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q 14	Professional development workshops on how to use maths textbooks are conducted in my province.	Respondents	1	5	7	19	21	29
		Percentage of responses	1%	6%	9%	23%	25%	35%

Table 4.13 shows that 29 (35%) teachers said that staff development workshops on how to use the mathematics textbook were never held in the Mashonaland East Province. Twenty-one (25%) teachers indicated that these workshops were very rarely conducted, 19 (23%) reported they are rarely held. When added together, 69 (83%) teachers reported the non-existence or the near absence of staff development workshops. Only one (1%) teacher indicated that staff development workshops were always held in the province. This teacher was most likely referring to school-based staff development workshops at his or her school.

The interviewees were asked whether they had been trained on how to use textbooks in the teaching and learning of mathematics. Their responses confirmed the questionnaire responses, and showed that no significant formal training focused on the use of mathematics textbooks.

Some of the responses of the teachers to this question were:

Mr. Badza: *When these new textbooks came to the schools we were not work-shopped on how to use them.*

Mrs. Demo: *I feel it is important to train teachers on how to use textbooks because at times you use it wrongly but unknowingly.*

Ms. Mbezo: *We were not trained on how to use the textbooks. We would require training in textbook use to include the content, activities to be done during the lesson, and how to explain the mathematical language.*

Mr. Banga: *In the past book publishers would conduct seminars on how their new textbook catered for the syllabus, and how we could use it together with the teachers' resource book. They do not do that anymore.*

These responses show that the need existed for staff development workshops in order to help the teachers to use the textbooks more effectively. For example, the teachers expected staff development programmes on the best ways to use the textbook after the textbooks were distributed to the schools, yet this was not done. Mr. Banga's response is pertinent in that it highlighted the need for textbook publishers and possibly the authors, to be in constant liaison with the teachers. Staff development which takes place at this stage has several advantages. Ornstein and Hunkins (2004, p.303) correctly observed that, "This kind of training has the necessary flexibility to respond to the changing needs of staff, since not all details of in-service training can be planned for prior to implementation, and all problems and concerns cannot be anticipated." These unmet expectations or needs are a possible source of teacher resistance to the use of this textbook (see section 4.3.3.4).

The general feeling from the interview responses was that such training was necessary and that it should ideally include a discussion of the textbook content, activities to be done during the lesson, possible investigations or project work, perhaps giving the teachers examples of the

teaching aids suitable for the lessons, and how to deal with the difficult mathematical language. In this regard, Obara and Sloan (2009) pointed out that professional development programmes should provide teachers with the opportunities to share and reflect on their existing instructional practices, to work in groups in order to better appreciate how to use new materials, and to experience new approaches to teaching. Obara and Sloan (2009, p.364) cited Ball (1997) who asserted that, “Teacher development is especially productive when teachers are in charge of the agenda, determining the focus, nature, and kind of programming”.

Staff development workshops are important for both inexperienced and experienced, or highly qualified teachers, because they serve as in-service training, they bring the teachers up-to-date with current developments in the field of learning, and how curriculum implementation can be enhanced. Such teacher-support through workshops is also an important way of eliminating or reducing teacher isolation, since it creates a forum to share ideas and solve problems faced by individual teachers, thereby boosting their confidence when using the textbook. The literature that the researcher reviewed points to the importance of these teacher-support programs. For instance, Ornstein and Hunkins (2004, p.303) pointed out that “educators often require in-service training or staff development time to feel comfortable with new programs”. In addition, Christie et al. (2007, p.107) observed that the teachers’ knowledge of what they are teaching “determines the quality of learning, motivation and/or will on the part of teachers and learners”. Similar calls for professional development which focuses on how best to use new mathematics textbooks have been made in other studies on textbook use by the teachers (Jamieson-Proctor & Byrne, 2008; Lawrence, 2011; Ying & Young, 2007).

As was reported earlier (see section 2.5), the extent to which the teachers use these mathematics textbooks and the quality of their use depend on the pre-service teacher training they received and/or the on-going teacher support programmes. The teachers need more training on how to use the textbook in teaching and learning mathematics. The teachers’ suggestion for staff development workshops to be held more regularly in the province is consistent with what Stein and Kaufman (2010, p.671) described as ‘enhancing teacher capacity’. *Teacher capacity* encompasses ‘teachers’ education, teachers’ experience in teaching, and mathematics professional development hours per year’. These workshops can empower the teachers to

provide high quality textbook use, where they pay attention to what the learners do and say as they work on textbook-based tasks. Antony and Walshaw (2009) shared a similar view that a teacher's pedagogical content knowledge can be refreshed or improved through such teacher workshops.

It is generally agreed that the provision of textbooks alone will have little effect unless it is accompanied by investing in upgrading the quality of the teachers (Christie et al., 2007; Coltart, 2013; Shafiuddin, 2010) in the form of strengthening their knowledge of mathematical content and methodology. In this regard, Obara and Sloan (2009, p.351) said, "Studies (Bay, Reys & Reys, 1999; Collopy, 2003; Remillard, 1999) indicate that textbooks may contribute to change in teaching if teachers are supported through professional development activities". Professional development programmes should, therefore, sharpen the teachers' textbook interpretive skills, as also suggested by Ying and Young (2007). However, this staff development has to be done not only at provincial level, but also at national, district, cluster or school level, and needs not to be a once-off meeting, but should be on-going. It could also utilise textbook authors and teacher training college lecturers or university staff as resource persons.

4.3.2.5 The extent of the coverage of the textbook, and the use of other resource materials

The teachers were asked to indicate how much of the textbook content they covered, whether they skipped some of the contents of the textbook, and whether they used resources other than *Step in New Primary Mathematics Grade 7* textbook. In answering these questions the respondents were also asked to give reasons for and/or examples of what they skipped, and of the other resources that they used.

These practices are discussed next.

Table 4.14: Summary of the teachers’ responses on the coverage of the textbook content and use of supporting resource materials.

	Questions	Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q.1 5	I cover all the textbook content.	Respondents	15	21	22	13	9	2
		Percentage of responses	18%	26%	27%	16%	11%	2%
Q.1 6	I select what is important and skip the rest.	Respondents	23	22	12	12	5	8
		Percentage of responses	28%	27%	15%	15%	6%	10%
Q.1 7	I incorporate activities from other sources.	Respondents	45	16	16	2	1	2
		Percentage of responses	55%	20%	20%	2%	1%	2%

Table 4.14 shows that only 15 (18%) and 21 (26%) of the teachers respectively confirmed that they ‘always’ or ‘very frequently’ covered all the content in the mathematics textbook. The same table also shows that 22 (27%) of the respondents ‘occasionally’ covered all the textbook content, and that 13 (16%) ‘rarely’, 9 (11%) ‘very rarely’ and two (2%) ‘never’ covered all the textbook content. Among the 15 (18%) respondents who always covered all the content in the textbook were teachers at the two boarding schools that formed part of this study sample. The teachers at these schools were able to do so because, in addition to using the time allocated for mathematics on the school timetable, they also used the afternoons, evening study time and early mornings before the start of each day’s lessons for additional lessons.

Also from Table 4.14, and in response to closed-ended question 16, it can be seen that twenty-three (28%) teachers ‘always’ selected what is important from the textbook and skipped the rest, 22 (27%) did so ‘very frequently’, 12 (15%) ‘occasionally’, 12 (15%) ‘rarely’, five (6%) ‘very rarely’ and eight (10%) ‘never’ skipped any of the content of the textbook.

The interviews with the teachers on the extent of their textbook coverage produced the following answers:

Ms. Pfumo: *I cover more than 60% of the textbook content. I do not use all the activities because the content in the textbook is too much.*

Ms. Mbezo: *I cover close to 90% of the textbook content, because some exercises are challenging and other school activities disturb full coverage. Sometimes the exercises are not adequate, so I supplement with other textbooks.*

Mr. Badza: *I cover approximately 70% of the textbook content because there are so many exercises and so you cannot use all of them, otherwise you will spend too much time on one topic at the expense of covering the syllabus.*

Mrs. Demo: *I cover about 70% of the textbook because I have a composite class. At times I use content from Book 6 and other content from Book 7.*

In percentage terms, these teachers estimated their coverage of the content of the textbook at between 60% and 90%, meaning that the remainder was either the exercises that were skipped, it was covered from other sources, or it was not covered at all. Responses to closed-ended question 15 in Table 4.14 confirm that the teachers' coverage of the textbook content varied significantly. These statistics are close to what McNaught et al. (2010) found in a study in American high schools, namely that up to 32% of the mathematics content was not taught (see section 2.4).

Even in the lessons that were observed the teachers did not use all the content that was provided. For instance, where there were 4 or more worked out examples per exercise, the teachers used only one or two of them; and where an exercise consisted of many questions, the learners were asked to answer only the even-numbered or the odd-numbered questions. The teachers also skipped the *Try again* and *Look ahead!* exercises that were found at the end of every chapter.

Covering all of the textbook content is one sure way of preparing the learners for the end-of-year

examinations, especially when this is the core textbook for mathematics at the school. It is in this regard that the Department of Basic Education (2013b, p.6) commented that, “Covering the entire curriculum or textbook for each grade will enable learners to acquire requisite knowledge and skills for applications of mathematics: Learners should learn all the content intended for a specific grade”. However, in schools where other mathematics textbooks were available, it is possible that the coverage of the syllabus was achieved by means of the use of these complementary textbooks, as shown in the teachers’ responses to question 17 in Table 4.13. This, in part, helps to explain why some teachers did not cover all the content in *Step in New Primary Mathematics Grade 7* textbook.

The teachers were selective in the content that they used from the textbook, and their choices were largely determined by the level of difficulty of that part of the textbook, and by the amount of time available to cover the content. As in the study by Lo et al. (2008), reported on in chapter 2 (see section 2.4), the six grade 7 teachers in the Mashonaland East Province skipped or added some content to that provided in the textbook. This came out clearly in the questionnaire responses, the interviews with the teachers and the lesson observations, as reported above. Although some respondents supported their practice by stating that they also incorporated work from other sources where the concepts were explained or presented in a clearer way, there existed a real possibility that some content may not be taught at all. Some schools did not have these additional resources, and if the teachers in such schools could not cover all the content in the *Step in New Primary Mathematics Grade 7* textbook for whatever reason, it may mean that their learners may not be fully prepared for the end-of-year final mathematics examination. However, there also exists the view that it is not always the coverage of all the textbook content that matters, but the *quality* of content coverage (Perso, 2006; Stein & Kaufman, 2010). In other words, content coverage is not always synonymous with good teaching practice, yet it is desirable to have both.

- The teachers' use of resources other than the *Step in New Primary Mathematics Grade 7* textbooks:

The teacher responses to closed-ended question 17 shown in Table 4.14 indicate that the majority, 45 (55%) teachers made use of other sources in addition to the *Step in New Primary Mathematics Grade 7* in teaching mathematics. Only two (2%) 'rarely', one (1%) 'very rarely', and two (2%) 'never' used other resources in teaching grade 7 mathematics.

Questionnaire responses to open-ended item 7 on the teachers' use of resources other than the *Step in New Primary Mathematics Grade 7* textbook confirmed that some teachers still regarded the *New Ventures in Mathematics* textbook as their main textbook. This was evidenced by the following 2 responses:

Respondent 1: *After using the main textbook-New Ventures in Mathematics-I add on other information from the Step in New Primary Mathematics Grade 7 which will not be in the main textbook that I use.*

Respondent 2: *I use the Step in New Primary Mathematics Grade 7 textbook as a secondary source to consolidate the New Ventures in Mathematics.*

The sentiments expressed in these two teachers' comments are reflective of teachers who "relied heavily on past experience to guide their instructional decisions; and had used the old books for several years and were very comfortable with them" (Obara & Sloan, 2009, p.365). However, other questionnaire-respondents indicated that they also used charts, real life objects, and other mathematics textbooks in their lessons.

The interviews confirmed that teachers used other mathematics textbooks, such as *Maths in Action; Let's do Maths* and Zimsec past examination question papers. Asked how often they used these other resources and why, this is what two of the teachers said:

Ms. Pfumo: *It depends on the topic. Sometimes it is adequately covered in the textbook Step in New Primary Mathematics Grade 7 so that there is no need to use other resources,*

but at times a topic is covered more clearly in New Ventures in Mathematics, and so that is when I use it.

Mrs. Demo: *I do so whenever it is necessary, especially when I feel there are easier and clearer examples from another textbook.*

The lesson observations revealed that the teachers used the *Step in New Primary Mathematics Grade 7* textbook most of the time, and other resources to a lesser extent. For instance, Ms. Pfumo used *New Ventures in Mathematics* to give the learners homework, but the rest of the class work was taken from the *Step in New Primary Mathematics Grade 7* textbook. Another teacher, Mrs. Gano, used real life 3-dimensional shapes to consolidate concepts that were presented in the *Step in New Primary Mathematics Grade 7* textbook.

The foregoing accounts on the teachers' use of resources other than the *Step in New Primary Mathematics Grade 7* textbook confirm the views given by Nicol and Crespo (2006) that teachers tend to use a textbook in deciding what and how to teach in qualitatively different ways. Those teachers who relied almost entirely on the one textbook were labelled as the 'textbook adherents' (Hall, 2004; Ying & Young, 2007). The second group of teachers were those who elaborated on the textbook; they treated the *Step in New Primary Mathematics Grade 7* as the main textbook but saw the need to fill in its gaps with other supplementary textbooks or concrete/real life objects.

The teachers also added content from sources other than the *Step in New Primary Mathematics grade 7* textbook, especially other textbooks and past examination question papers. The reason for this was the need for variety and that a concept or topic may be more adequately explained in another source. The use of charts and real life objects in their mathematics lessons helped the learners to understand the concepts better. Moreover, the learners saw or experienced some of these things at home, and so they came to think of them as relevant and worthwhile, what Chikodzi and Nyota (2010, p.12) referred to as "culturally relevant pedagogy." This could result in a more positive attitude towards mathematics.

The use of past examination question papers emphasised the teachers' pre-occupation with ensuring that the learners passed mathematics at the end of the year. Therefore the learners should practise using the expected standard, so that they may be familiar with the nature of external examining. However, as Chikodzi and Nyota (2010) further cautioned, while this exposure to examination type questions is important, the teachers need not lose sight of presenting the subject in ways that the learners come to enjoy mathematics, and to view it as socially and culturally relevant.

Surprisingly, there was a 'deafening' silence on the use of ICT that could complement the textbooks, thereby enhancing the teaching and learning of mathematics. Current trends attempt to link mathematics to real life situations, and this includes integrating the latest technologies into the mathematics curriculum. Constructivists view one of the teachers' roles as that of fostering the learners' autonomy in terms of the search for information through the use of textbooks and other learning materials (Carr, 2006). In all the questionnaires and interviews none of the respondents mentioned the use of technologies such as the television, computers, websites or the internet as additional teaching and learning resources. This silence in itself indicates the lack of these important learning resources in the sample schools, despite the fact that all these schools had electricity and a good network reception. Accordingly, this revelation confirms the views expressed earlier in chapter 2 (Jamieson-Proctor & Byrne, 2008; Johansson, 2006; McNaught, 2005; Rezat, 2006; Santos et al., 2006) that mathematics textbooks remain a valuable modern-day reality and the mainstay in primary mathematics classrooms – at least in the majority of developing countries like Zimbabwe.

4.3.2.6 Conclusion to research question 2

A variety of factors influenced the teachers' use of the *Step in New Primary Mathematics Grade 7* textbook. Both positive and negative factors were addressed in answer to research question 2. The positive factors are the aspects that the teachers said they liked, such as the clearly worked out examples, the homework, and the *Try again* and *Look back* sections of the textbook. The negative factors of the textbook were discussed in four main categories, namely the textbook-factors, the learner-factors, the teacher-factors and policy-factors. The perceived difficult

language used in the textbook, the use of big numbers, and the textual errors were some of the factors that influenced how the teachers used this textbook. The limited confidence of the teachers, inadequate pre-service and in-service teacher training, particularly focusing on the use of mathematics textbooks, were the teacher-related factors that were identified and discussed in answer to research question 2. It was highlighted that the effective use of the textbook depends on teacher training, and that research on how the teachers use the textbooks should be the backbone of an authors' work. These factors affect the quality of textbook use, and could result in the teachers' resistance to new curriculum initiatives. Some learners were frequently absent from school, and this affected their proficiency in mathematics. School policies which do not allow the learners to take the mathematics textbooks home also limit what the teachers and learners can accomplish when using these textbooks.

4.3.3 Research question 3:

What impact has the *Step in New Primary Mathematics Grade 7* textbooks had on the teaching and learning of mathematics?

This last research question sought to ascertain how the textbooks have influenced the teaching and learning of mathematics, whether positively or negatively. The results are presented and discussed in this section.

4.3.3.1 The teaching of mathematics made simpler

Prior to the introduction of the *Step in New primary Mathematics Grade 7* textbooks most schools in the country had very few textbooks, and which had to be shared. In some cases only the teacher had a textbook (see section 1.1). Given this background, it was necessary, as part of this study, to find out how the use of these 'new' textbooks impacted on the teaching and learning of mathematics.

Table 4.15: The teachers’ responses on whether the use of the textbook makes the teaching of mathematics easy and interesting.

	Question	Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q.19	The textbook makes teaching mathematics easier.	Respondents	10	21	25	17	3	6
		Percentage of responses	12%	25%	30%	21%	4%	7%
Q.20	The textbook makes the teaching and learning of mathematics interesting.	Respondents	10	22	29	12	4	6
		Percentage of responses	12%	27%	35%	15%	5%	7%

In response to closed-ended question 19, Table 4.15 shows that ten (12%) teachers agreed that using this textbook ‘always’ made the teaching of mathematics easier, 21 (25%) indicated that the use of the textbook ‘very frequently’ made teaching easier, 25 (30%) said it did so ‘occasionally’, 17 (21%) ‘rarely’, three (4%) ‘very rarely’, and six (7%) ‘never’.

In a related question, teachers were asked whether the use of this textbook makes teaching and learning of mathematics interesting. Their responses to this closed-ended question 20 as displayed in Table 4.15 were: 10 (12%) teachers stated it always, 22 (27%) very frequently, 29 (35%) occasionally, 12 (15%) rarely, 4 (5%) very rarely, and 6 (7%) never.

The respondents, in the questionnaires, were divided on whether the *Step in New Primary Mathematics Grade 7* textbooks made the teaching and learning of mathematics easy and interesting, as presented in Table 4.15. However, when added together the ‘always’, ‘very frequently’, and ‘occasionally’ categories of respondents tended to confirm that the majority felt the textbooks made teaching and learning easy and interesting. The ‘never’ category of respondents could, in part, be made up of those teachers who chose not to use the textbooks at all, although the books were supplied to their schools. It also follows that if the teachers found it

interesting then it would catch on to the learners as well, with the result that the mathematics lessons became an enjoyable experience (for both learners and teachers), worth looking forward to each day (Carr, 2006; Susuwele-Banda, 2005).

The teachers were unanimous in the interview responses that the availability of the mathematics textbooks made things a lot easier for them and for the learners, as reflected in the following statements.

Mrs. Demo: *Previously only the teacher had a copy of the mathematics textbook, but now we can use the textbook more, both the teacher and the learners.*

Mrs. Gano: *This textbook has really changed our approach because previously when we used to write on the chalkboard we were limited on the number of questions we could write, we got tired, or the chalkboard space ran out. Now with the coming of this new textbook we are giving as much written work as possible.*

Mr. Banga: *Every day we are using them, every learner will have his/her copy in front of him/her, and I also have mine.*

The availability of the textbooks also resulted in the teachers having to write less on the chalkboard. Previously the teachers used to copy all the work from the textbook onto the chalkboard. This often meant that either there was not enough space on the chalkboard or the teachers became tired or were too lazy to write down all the work. Although the teachers still copied the examples from the textbook onto the chalkboard in order to explain the process of solving the problems, they did not have to do so for the class work or for the homework and revision exercises. This resulted in saving time for both the teachers and the learners, and less or no transcription errors. Therefore more time was now spent on the actual mathematical tasks.

The respondents indicated that the improved availability of the mathematics textbooks made it possible to use them more. The textbooks were handy when the teacher and the learners had to look at and discuss the diagrams and pictures in the book, something which they could not do

previously because of the unavailability of the textbooks. The teachers could now have the learners read and comment on the concepts being emphasised. The teachers could identify the learners with reading problems, and find ways of assisting them. Another interesting and significant revelation from the study was that some teachers asked the bright learners to help their slower counterparts to use the mathematics textbook. The study found that the teachers could now give their bright learners work to do from the textbook without them having taught it first. This helped to make the teaching more learner-centred, as the learners could study the completed examples and proceed with new work. The teachers stated that they could now set more work for the learners to do at home, especially in schools where the policy allowed the textbooks to be taken home. The learners now had a greater opportunity to practise mathematics.

The general picture from the teacher interviews was that the use of the *Step in New Primary Mathematics Grade 7* textbook has impacted positively on the teaching and learning of mathematics. The textbook brought relief to the teachers in the sense that since they could all be looking at the same page, it became easier to explain concepts, and saved time otherwise wasted in writing the same work on the chalkboard. Since the learners would be looking in their own textbooks and reading for themselves, they could draw the teachers' attention to any mistakes they may be making. This is different from the past, when only the teacher had a textbook, and the teachers' mistakes in copying or reading from the textbook would go unnoticed. In terms of learner performance and interest in the subject, three out of the six respondents reported in the interviews that the learners had now changed their attitude towards mathematics; it was now more positive.

This is what some of the teachers said:

Ms. Mbezo: *Even when it comes to the grade 7 examination or end of term examination, you could hear some children say 'I saw this problem in the textbook, it is just the same as it was'. So you can see the textbook has had a strong impact on the teaching and learning of mathematics.*

Ms.Pfumo: *It (the textbook) has changed the learners and has also relieved me in that we can all be looking on the same page in the textbook, making it easier to explain concepts. In the past all the learners could do was listen to me talking without seeing what I was talking about unless it was written on the chalkboard. Some learners are now self-motivated to the extent that you find them doing some mathematics exercises on their own.*

For some of the teachers this was the very first time in their teaching career that they had taught classes where the mathematics textbook-to-learner ratio was 1:1. The teachers could therefore influence the learners to use their textbooks during and after the mathematics lessons to work on textbook-based tasks. The teachers confirmed in the interview and questionnaire responses that the confidence levels of both the teachers and the learners in mathematics have increased. In addition it was confirmed in the lesson observations that there now existed greater enjoyment and participation in mathematics lessons on the part of the learners.

4.3.3.2 Opportunities for the teachers to learn

The use of the *Step in New Primary Mathematics Grade 7* textbook has provided many teachers with new ideas about mathematics and how it is taught and learned. This was the affirmative response given by a good number of teachers in response to closed-ended question 18, as shown in Table 4.16.

Table 4.16: Summary of the teachers’ responses on whether using the textbook provided them with new ideas on how mathematics is taught and learned.

	Question	Responses	Always	Very frequently	Occasionally	Rarely	Very rarely	Never
Q18	The textbook has provided me with new ideas about mathematics and how it is taught and learned.	Respondents	17	16	25	16	3	5
		Percentage of responses	21%	19.5%	30%	19.5%	4%	6%

Table 4.16 shows that 17 (21%) of the teachers agreed that the textbook always provided them with new ideas about mathematics and how it is taught and learned, 16 (19.5%) said ‘very frequently’, and 25 (30%) ‘occasionally’. However, some teachers did not seem to benefit much from this textbook, as reflected by the five (6%) ‘never’, 3 (4%) ‘very rarely’, and 16 (19.5%) ‘rarely’ responses. This could mean that these teachers did not use the textbook at all, or that they used it only occasionally. Overall, it meant that this ‘new’ textbook was valuable to the majority of the teachers, both as a teaching tool, and as a tool for the development of the teachers on how to teach mathematics, and on how children learn mathematics. Remillard and Bryans (2004) referred to this as an opportunity for teacher learning, emanating from the new experiences and insights presented to them in the process of using this textbook.

Concerning opportunities for teacher learning, the teachers were asked the following question in the interviews:

Interviewer: *What new things have you learned as a result of using this textbook, and what has changed in the way you now teach mathematics?*

Mr. Banga: *I now realise the importance of starting each lesson with mental exercises, they are beneficial to the learners.*

Ms. Mbezo: *Some textbook problems are challenging for the learners so I have learned to use interactive teaching and learning more. For example, word problems are read in groups and learners decide on a method to use in finding a solution.*

Mrs. Gano: *I now appreciate and use the breaking-down methods for addition and subtraction. Although they take more time, they are helpful to slow learners. For example the quick method for adding five-digit sums is*

$$\begin{array}{r} 12456 \\ +34211 \\ \hline =46667 \end{array}$$

The breaking-down method is

$$\begin{array}{r} 12456 \\ +34211 \\ \hline 7 \text{ (add the ones)} \\ 60 \text{ (add the tens)} \\ 600 \text{ (add the 100's)} \\ 6000 \text{ (add the 1000's)} \\ \underline{40000} \text{ (add the 10000's)} \\ =46667 \end{array}$$

In essence, these teachers' responses suggested the need for the inclusion of mental exercises in the textbook, as well as consciously using more interactive teaching methods, and exposing the learners to a variety of methods for solving mathematics problems.

4.3.3.3 Improved learner performance

Some of the responses to open-ended questionnaire item 7 revealed that the use of the textbook has improved the performance of the learners in mathematics. The positive attitude and improved performance could be interpreted as emanating from an increased school attendance, increased learner participation in the lessons, and the enjoyment and aesthetic value derived from learning mathematics. The end result is an expected increase in the pass rates at the end of the year.

The interviewees felt that the learners' attitudes were now more positive towards mathematics, which was likely to translate into improved pass rates in the subject. If this is true, then it would seem to confirm the views advanced by Kwaramba (2012), and Nicol and Crespo (2006). Kwaramba reported that learner school attendance at Gwanyani Primary School in Plumtree, Zimbabwe, had improved significantly since the launch of the ETF textbook initiative. This improved performance was confirmed in this Zimsec report: "Meanwhile, the national pass rate for the 2013 grade 7 examination is 32,2%. In 2012 the pass rate was 31,5%, up from the 2011 rate of 28,89%." (Herald Reporter, 2013). In contrast, the grade 7 national pass rate had fallen to 20,11% in 2009, a year prior to the launch of the new textbook initiative (Coltart, 2010). Nicol and Crespo (2006) argued that the new mathematics textbooks were a source of motivation for the teachers, the learners and the parents, and served as a discipline tool for the learners, as they helped to keep the learners on task, and 'forced' them to work harder.

The respondents stated that the learners' performance in mathematics had or was likely to improve as a result of using the *Step in* textbooks. In this regard, and as mentioned earlier (see section 2.6), Abadzi (2006) provided empirical evidence from studies in several developing countries in Africa, Asia, and South America which confirmed that the learners' performance improved when sufficient textbooks were supplied. In part this was attributed to the fact that the adequacy of textbook-supply increased instructional time otherwise lost when the teachers had to copy all the information from the textbook onto the chalkboard. A similar expectation in the Mashonaland East Province of Zimbabwe would not be far-fetched, given the fact that the learners now had sufficient mathematics textbooks. In this respect one primary school headmaster in the Chivi District (Masvingo Province) was quoted as stating that, "The performance has now improved because of the availability of these textbooks" (Unicef, 2013, p.2).

However, as Green and South (2006, p.35) cautioned, "There may be a time-lag between an intervention and the emergence of behavioural effects". This delay in impact Green and South called the 'sleeping effect', and pointed to the fact that the desired effect in behaviour does not happen throughout the entire system at the same pace, even when all the other variables are kept constant.

4.3.3.4 The teachers' resistance to the *Step in New Primary Mathematics Grade 7* textbook

However, it also emerged from this study that there were some teachers who did not use the textbooks at all, and others who only used them to a limited extent. Some teachers' responses tended to give an unsolicited comparison between the *Step in New Primary Mathematics Grade 7* and the *New Ventures in Mathematics* textbooks.

For example, one teacher said:

Ms. Mbezo: *I am not happy with the way the topics are arranged, because we normally base with the *New Ventures in Mathematics* textbook.*

In fact an interesting finding of this study was that some teachers continued to use the *New Ventures in Mathematics*- the textbook that was in use in most schools prior to the advent of *Step in New Primary Mathematics Grade 7*- even though they had a limited number of copies or only a single copy in the school. These teachers were prepared to copy all the work from the *New Ventures in Mathematics* onto the chalkboard, yet they had enough copies of *Step in New Primary Mathematics Grade 7* to go round all the learners, but were kept locked in classroom cupboards.

It is not too difficult to explain why some teachers displayed this resistant attitude if one considers the revelations of the informal interview with one school headmaster, as reported below.

➤ Informal interview with one volunteer primary school headmaster

The researcher had the opportunity to informally interview one school Head who offered to be interviewed. This Headmaster gave the impression that, given a choice, the schools or the teachers would have preferred the *New Ventures in Mathematics* to the *Step in New Primary Mathematics Grade 7*, hence the lack of interest in and resistance to the latter textbook. He also pointed out that some schools do not use the *Step in New Primary Mathematics Grade 7*

textbook at all, or they only use it as a supplementary textbook, depending on their resources. The initial remarks from the headmaster were:

Headmaster: *You cannot turn away donated textbooks, especially when you are a poor school. The rural schools were forced to accept the 'Step in' textbook series because they are generally poor.*

Interviewer: *How did the Step in New Primary Mathematics Grade 7 textbook come about?*

Headmaster: *An initial textbook survey that was conducted country-wide by the Ministry of Education, Sport, Art and Culture revealed that the New Ventures in Mathematics was widely used in schools, but surprisingly this was ignored and the tender was awarded to Longman, the publishers of the Step in New Primary Mathematics Grade 7 textbook. The schools would have preferred the New Ventures in Mathematics because they have been using it for a long time, and it has less errors than the Step in New Primary Mathematics Grade 7.*

This Headmaster felt that the tender awarding process had been flawed, and lacked transparency.

Headmaster: *The Step in New Primary Mathematics Grade 7 textbook is not easy to use, especially for teachers who are new from teacher training college, largely because it incorporates too many concepts in one exercise.*

The remarks in the interview with the Headmaster (above) lend credibility to and reflect a certain level of resistance to the *Step in New Primary Mathematics Grade 7* textbook and a preference for the *New Ventures in Mathematics*. If such resistance comes from the Head of a school, chances are that either the teachers in the school would be influenced similarly, or it served to reinforce their already negative perceptions of the textbook. In fact, and contrary to the Headmaster's argument, it was the newly qualified teachers who may actually have been more receptive to these textbooks because, as Obara and Sloan (2009, p.366) argued, "They have not been teaching long enough to settle into a particular way of doing things and could not rely on

years of experience to guide them”.

Some of the literature reviewed points to the real possibility of resistance or slow adoption of new curriculum projects, such as the introduction of the *Step in New Primary Mathematics Grade 7* textbook in this study (Green & South, 2006; Rogers, 2003; Sahin, 2006). For instance, the ‘diffusion of innovation theory’ (Rogers, 2003) acknowledges that people’s rate of adoption of a new curriculum varies. Rogers (2003, p.177) describes *adoption* as the “full use of an innovation as the best course of action available”. By their nature most innovations bring a certain degree of uncertainty, and implementers – in this case the teachers – may need “some assistance from change agents and others to reduce the degree of uncertainty” (Sahin, 2006, p.17). Similar sentiments were expressed in the two citations below by Obara and Sloan (2009, p.363), namely that

“Change is a journey, not a blueprint. Change is non-linear, loaded with uncertainty, and sometimes perverse” (Fuller, 1993, p.24), and “changing the curriculum also involves changing individuals” (Taba, 1962, p.455). This could help to explain why some respondents in this study said they did not use, or they rarely used the *Step in New Primary Mathematics Grade 7* textbook. The teachers often felt it was better to maintain the *status quo*, and they viewed any change as bringing about more work, which required them to acquire new teaching skills and new competencies. As the Department of Basic Education (2013b, p.3) acknowledges, “Teaching a curriculum they did not learn and using approaches they did not experience are big challenges for teachers, especially the latter”. This, Green and South (2006) said, becomes a barrier to change, even if the change is an improvement of the prevailing conditions, as was the case with the introduction of the ‘new’ mathematics textbook in this study. Rejection or the slow adoption tends to deprive the learners of the opportunity to have their own mathematics textbooks and to learn from them.

There was, however, no evidence in the lessons that were observed of teacher resistance to this textbook. Instead, the teachers used other textbooks to supplement the work in this textbook, as reported in section 4.3.2.5.

Green and South (2006, p.4) described evaluation as integral to good practice, and that it helps

“to check whether the benefits of an intervention reach those most in need.” In addition, Green and South (2006, p.35) pointed out that evaluation studies help to determine “whether and how an intervention has changed things; what impact the intervention has had on such indicators as teacher morale, work completed, and learner performance”. It emerged from this study that all the deserving schools received adequate or nearly adequate copies of the *Step in New Primary Mathematics Grade 7* textbooks. For poor schools strapped for resources these mathematics textbooks filled a void that had existed for a long time, and so the question of whether to accept the textbooks or not, which Ornstein and Hunkins (2004) raised (above), did not arise in this situation. Rather, what are needed are changes to, or improvements in the quality of the textbook, and the preparedness of the teachers to use these textbooks more effectively. It also emerged from this study that certain school policies and teacher textbook use patterns needed reviewing, for example the policy which prohibits learners to take textbooks home.

4.3.3.5 Conclusion to research question 3

The majority of the respondents felt the *Step in New Primary Mathematics Grade 7* textbooks impacted positively on the teaching and learning of mathematics. The textbooks provided the teachers with new ideas on how mathematics is to be taught and learned, and this made teaching easier and interesting. Most of the teachers and learners were motivated, the learners’ performance improved, and higher pass rates were registered. There was resistance to the use of these textbooks by some of the teachers, meaning that although the textbooks were available in the schools, they were not used extensively. This resistance prejudiced the learners whose only chance it may have been to own and use a mathematics textbook.

4.4 SUMMARY

The findings from the study were presented, analysed and discussed in this chapter. By so doing the three research questions were answered.

- Most of the lessons observed revealed that, to a large extent, the teachers and the learners

used this mathematics textbook in constructive ways, both in whole class discussions and in small-group or individual work sessions.

- The responses in the questionnaires and the interviews were corroborative, but not all of the purported teaching and textbook use practices could be confirmed in the lesson observations. For example, it was observed that the teachers did not give as much autonomy to the learners to solve problems on their own as they claimed.
- In a number of the schools there was a slow adoption and even some resistance to this textbook, and some of the teachers continued the practice of writing questions on the chalkboard from the *New Ventures in Mathematics* for the learners to copy, even when there were adequate copies of the *Step in New Primary Mathematics Grade 7* textbooks.
- While the teachers mentioned some good aspects of the textbook, there were genuine concerns on the quality of the textbook that require urgent attention.
- The teachers with higher qualifications were more flexible in the ways they used this textbook, and in using more practical or familiar examples in order to help their learners to understand the mathematical concepts being taught.
- The study also revealed the need for regular in-service training to continuously update and sharpen the teachers' interpretive skills of the new curriculum material, in particular their textbook use skills. However, evidence from the study suggested that the use of the *Step in New Primary Mathematics Grade 7* textbook has had a positive impact on the teaching and learning of mathematics.

A summary of the study, recommendations, the limitations, and the conclusion of the study are presented in the next chapter.

CHAPTER 5

SUMMARY OF THE RESEARCH, RECOMMENDATIONS, AND CONCLUSION

5.1 INTRODUCTION

In this chapter is presented a summary of the research findings. The summary includes a brief statement of the problem, the questions of the study, and a discussion of the research methodology used to collect the data. The findings from the review of related literature are briefly presented, followed by a presentation of key findings from the empirical study. Based on the study findings the researcher then makes recommendations for how teachers can improve on the use of mathematics textbooks. Further research is suggested. The researcher also acknowledges the limitations of the study. The chapter ends with a study conclusion.

The study grew out of the recognition that since the launch of the ETF in 2010 in Zimbabwe, no empirical research had been conducted to show how well these textbooks have been used, and how this intervention had impacted on the teaching and learning of mathematics at grade 7 level. In order to understand how teachers used the *Step in New Primary Mathematics Grade 7* textbooks in Mashonaland East Province of Zimbabwe, the study considered the following 3 research questions:

- In what ways do grade 7 teachers use the *Step in New Primary Mathematics Grade 7* textbooks in their teaching?
- What factors influence how the grade 7 teachers use the mathematics textbooks?
- What impact has the use of the *Step in New Primary Mathematics Grade 7* textbooks had on the teaching and learning of mathematics?

5.2 SUMMARY OF THE LITERATURE REVIEW

A full review of the literature was presented in chapter 2. Social constructivism was the main theory that guided this study, and it was discussed in 2 parts, namely the socio-cultural and the constructivist perspectives (see section 2.3). In addition, 4 models on the use of the mathematics

textbooks were also reviewed (see sections 2.3.2 – 2.3.5).

There was consensus from the literature reviewed that an evaluation of the teachers' use of mathematics textbooks should involve describing the ways they interpret, restructure, simplify and use the textbook. International studies on teachers' use of mathematics textbooks revealed that teachers spent less time on the explanation and development of mathematics concepts, and more time on teaching the algorithms, followed by the learners' written exercises (see section 2.4).

Certain teacher factors encourage and facilitate mathematics textbook use, namely teacher experience, content knowledge, attendance of regular professional development workshops and teacher confidence. These factors make the teachers less dependent on the textbook, as evidenced by the teachers' selecting and skipping of some content, or by using supplementary materials (see section 2.6).

5.3 SUMMARY OF THE FINDINGS FROM THE EMPIRICAL STUDY

The summary of the findings from the empirical study is presented under the three research questions that guided this study, and each finding is presented under a specific theme.

5.3.1 Research question 1:

In what ways do grade 7 teachers use the *Step in New Primary Mathematics Grade 7* textbooks in their teaching?

- **Examples from real life**

Most questionnaire respondents reported using examples from the learners' backgrounds when explaining textbook concepts (see Table 4.9). However, in the lessons that the researcher observed only three out of six teachers (half the observation sample) were actually seen doing

that. The three teachers made clear links between the topics in the textbook with real-life objects, practices and phenomena. For example, they used 3-D shapes, referred to the pyramids of Egypt, and the rotation of the earth around the sun which results in day and night (see Mr. Banga's lesson, section 4.3.1.1). The use of real-life examples helps the learners to better understand some abstract concepts (see section 2.7).

- **Use of the vernacular**

The majority of the teachers simplified some of the language used in the textbook (see Table 4.10), and even used the learners' vernacular when explaining difficult mathematical concepts. This came out very prominently in the questionnaire responses and in the teacher interviews, and was corroborated by the lesson-observations. This practice stemmed from the teachers' admission in the interviews that the language used in this textbook was not easy for the grade 7 learners (see section 4.3.2.1). 'Language switching' is good practice, and is recommended (Antony & Walshaw, 2009; Carr, 2006; Rezat, 2005; Stein & Kaufman, 2010) as it helps the learners to develop the correct mathematical language. Examples of this practice were observed in Ms. Mbezo and Ms. Pfumo's lessons, where the teachers used Shona to explain the concepts 'equivalent' and 'discount' respectively (see section 4.3.1.1).

- **Developing the correct mathematical language**

The findings confirmed that some teachers used the textbook to help the learners develop the correct mathematical language (see Table 4.9). For example, in Ms. Mbezo's lesson, the learners were told that although $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{15}{30}$, we say they are 'equivalent' fractions, and the learners were expected to use this term in giving oral answers in this lesson.

- **Direct textbook-use**

The teachers spent most of the lesson-time explaining and developing the mathematics textbook concepts to the learners prior to asking them to work on the exercises. The rural teachers were

observed to spend most of their lesson time on direct textbook-use, a practice which confirmed an earlier argument that rural schools were more disadvantaged and benefitted the most from the ETF textbook initiative (see section 1.1). It was also the rural teachers who spent the least lesson-time without referring to the textbook in their teaching. The teachers occasionally made the learners to read out aloud questions from the textbook, discussed the pictorial or graphical information presented in the textbook with the learners, set individual or group-work and homework by referring the learners to specific pages in the textbook. All these practices helped to enhance the learners' mathematical literacy, problem-solving skills, and social learning, and to construct their own explanations and interpretations.

- **Sequence of the topics in the textbook**

A number of the teachers followed the sequence of the topics as they are presented in the *Step in New Primary Mathematics Grade 7* textbook, while others did not (see Table 4.8). This is consistent with findings from a study by Jamieson-Proctor and Byrne (2008) that traditionalist teachers follow the sequence of the textbook without modification, but constructivist teachers modify these or do not use the textbooks at all (see section 2.5). Of primary importance is the coverage of all the content in the syllabus. The order of coverage should ideally be dictated more by a logical sequence of concept-development than by the order of the topics given in the textbook.

- **Small-group discussions**

Group-work is a common strategy used in all the six 6 lessons that the researcher observed. The constructivist theory encourages small-group discussion which ideally should lead to report-back sessions to the whole class. This helps the learners to share and verify the correctness of their answers. However, in two of the six lessons that the researcher observed there were no report-back sessions after group-work (see section 4.3.1.2), thus denying the learners the necessary feedback.

- **The learners solving the problems in their own way**

In their responses in the questionnaires and the interviews the teachers said they allowed the learners to solve the problems from the textbook in their own way. However, there was no evidence of this at all in the lessons that were observed, thus confirming the charges that teachers tend to exaggerate what they say they do in respect of the textbooks, and that the teachers continue to teach primarily by rules and regulations (Moulton, 1994; Obara & Sloan, 2009; Susuwele-Banda, 2005). Such teaching practices run counter to the promotion of procedural fluency (see section 4.3.1.3).

- **Missed opportunities**

Some of the significant missed opportunities observed in the teachers' use of the mathematics textbook were the following, namely

- Ms. Pfumo remained silent on whether the answers on percentage discounts should be rounded off to the nearest whole number, or to one or two decimal places. This was an opportunity to re-visit the concept of 'rounding-off' decimals that the teacher did not take advantage of. The textbook also does not mention anything in this respect, a reflection of the textbook's poor quality (see section 4.3.1.8).
- Mr. Banga did not follow up on the learners' incorrect reading from the textbook, and also did not follow up on the learners' reasoning-process in working out textbook questions and arriving at an incorrect answer (see section 4.3.1.8).

5.3.2 Research question 2:

What factors influence how the grade 7 teachers use the mathematics textbooks?

- **The strengths of the textbook**

The teachers were happy with the *Look back* and *Try again* sections in the textbook, and they were satisfied with the textbook coverage of the syllabus topics, the clearly worked-out examples, and the many exercises per topic (see section 4.3.2.1). There are *Look back* exercises after every 4 or 5 chapters. These exercises can be used to test the learners' understanding of the concepts covered in each chapter. However, some teachers expressed unhappiness with the small number of questions in the Homework sections of the textbook, a situation which forced them to use other sources in order to add to these questions.

- **The sharing of textbooks**

These Education Transition Fund (E.T.F.) textbooks were allocated to the schools on the basis that there were 40 learners per class, yet in reality some classes consisted of 50 or more learners. Therefore, in some schools - 8% of questionnaire respondents - there was still some sharing of these textbooks. The problems of textbook-sharing were discussed in chapter 1 (see section 1.1). The finding that some of these textbooks were already stolen or lost worsened the situation of the sharing of textbooks in the affected schools.

- **Textbook language**

An additional problem was that the teachers felt the textbook language was difficult, and the examples used favour those in urban environments (see section 4.3.2.1), with the result that the rural teachers needed to do much more explaining and simplifying of the content in order to make it comprehensible to their learners (see Table 4.10). Therefore, time which could have been used on the actual solving of problems was spent on addressing the language challenges in the textbook.

- **Errors in the textbook**

Consensus existed among the teachers that the *Step in New Primary Mathematics Grade 7* textbook had some textual errors, and some incorrect answers. These are matters of textbook quality, as highlighted in chapter 2 (Lee, 2011; Ying & Young, 2007). Errors in the wording of the questions resulted in the wrong interpretation, or in ambiguity of meaning. The less conscientious teachers may continue to use the textbook with the incorrect answers unless they develop a habit of working out the answers to all the problems. Also, some of the prices used in this textbook were overly inflated (see section 4.3.2.1), and were not reflective of the price regime prevailing in the country. These unrealistic prices were not what the learners and the teachers experience in their shopping environments; hence they go against the grain of the socio-cultural perspective.

- **Large numbers in the textbook**

Some teachers expressed unhappiness with the large numbers that are used in the textbook, particularly in its first chapter (see section 4.3.2.1). These numbers are scary to some learners, and they struggle to read them correctly. Unfortunately it is a syllabus requirement that numbers up to ten million be covered as part of the grade 7 mathematics content (Logan & Tambara, 2010b:177).

- **Difficult home environments**

The parents of some learners are illiterate, and some learners live in child-headed families. These social backgrounds make it difficult for them to get help when using the mathematics textbooks at home, for example to do their homework (see section 4.3.2.2). The study established that even if the teachers wanted to extend the use of the mathematics textbook to the learners' homes these difficult home environments were a barrier, particularly in rural and peri-urban locations.

- **School textbook policies**

School policy differences exist in respect of whether the learners may take and use the mathematics textbooks at home or not (see section 4.3.2.3). In cases where policy allows the textbooks to be taken home, the learners have more time with the textbooks, can read and do homework directly from the textbooks, and their parents can assist them with that work if they are literate and numerate enough. Conversely, when the learners cannot take the textbooks home, it limits them in terms of the amount of work they can do from the textbook, and also takes up the daily teaching time, because the textbooks have to be issued and collected in every mathematics lesson.

- **Time constraints**

The time allocated for mathematics on the school timetable is limited. Most teachers expressed their concern in the questionnaires and interviews that it is difficult to cover all the content of the mathematics textbook within the allocated time (see section 4.3.2.3). This problem was even worse in schools where there were double-sessions, or where there were composite classes.

- **Composite classes**

The composite class in this study was at a poorly resourced rural/farm school; it consisted of too many learners in one class, and was taught by a teacher who had not received specialist training in teaching a composite class. This teacher taught all the learners in grades 6 and 7, using the *Step in New Primary Mathematics Grade 7* textbook, and set work for both groups from the same textbook pages (see sections 4.3.1.8 and 4.3.2.3). Ideally the teacher should have used the grade 6 mathematics textbook for setting work for the grade 6 learners.

- **The teachers' confidence**

A cumulative 19 (23%) questionnaire respondents (19 of the 82 teachers) expressed low confidence levels in teaching all the topics in the *Step in New Primary Mathematics Grade 7*

textbook (see Table 4.12). Although all the six teachers who were interviewed felt confident in teaching all the textbook topics (see section 4.3.2.4), the 23% questionnaire response is an unacceptably high percentage, and a cause for concern because the lack of or the low confidence of the teachers is likely to result in the avoidance of or the superficial coverage of some topics in the textbook. As reported earlier in the literature review (see section 2.5), Collopy (2003) established that confident teachers tend to use new mathematics textbooks in more creative and constructive ways.

- **Professional development programs**

This study revealed that professional development workshops are rarely conducted in the Mashonaland East Province. The questionnaire responses (see Table 4.13) corroborated the teacher interview responses (see section 4.3.2.4) on this aspect. Professional development workshops have been found to be important (see section 2.5) in helping the teachers deal better with the implementation of new curriculum initiatives, and in reducing the teachers' isolation, anxieties and uncertainties (Jamieson-Proctor & Byrne, 2008; Lawrence, 2011; Ogbonnaya, 2011, Ornstein & Hunkins, 2004; Ying & Young, 2007). These programmes also have the potential to improve the teachers' knowledge of where the learners have misconceptions in specific mathematics topics (Ibeawuchi, 2010).

5.3.3 Research question 3:

What impact has the *Step in New Primary Mathematics Grade 7* textbooks had on the teaching and learning of mathematics?

- **Learner interest and performance**

The learners now showed a greater interest in doing mathematics and they had more opportunities for practice. This interest has translated into improved learner performance in mathematics (see section 4.3.3.1). The result has been better pass-rates in mathematics. In

addition, it was established that these textbooks served as a discipline ‘tool’ because they kept the learners focused on the set tasks. An added benefit was the boost in school attendance by the learners, attributed to the availability of textbooks (see section 4.3.3.3).

- **Textbook concepts easier to explain**

The *Step in New Primary Mathematics Grade 7* textbooks have brought much relief to the teachers as it was now easier to explain some concepts when all the learners and the teacher are on the same page (see Table 4.15 and section 4.3.3.1). In many classrooms and for many teachers this was the first time that the mathematics textbook: learner ratio was 1:1, hence no sharing.

- **Opportunities for the teachers’ learning**

The study also established that these textbooks have provided some teachers with new ideas on how mathematics is taught and learned (see Table 4.16), thus providing opportunities for teacher learning (see section 4.3.3.2). For instance, the Department of Education (2013c) postulates that the performance of learners can point to areas of strength and weakness in the teaching approaches used by the individual teachers. As a result, the teachers can improve on their identified weaknesses.

- **Increased use of the textbook**

The availability of the *Step in New Primary Mathematics Grade 7* has resulted in both the teachers and the learners using this textbook extensively (see section 4.3.3.1). The teachers and the learners can be on the same page, instead of the work being copied from the teacher’s textbook onto the chalkboard, as had been the practice in the past. The learners could now use the textbook at school and at home, where the school policy allowed the textbooks to be taken home. But this increase in textbook-use did not necessarily translate into covering all the content in the textbook (see Table 4.14 and section 4.3.2.5). Whereas the literature reviewed (Department of Basic Education, 2013b; Lee, 2011) encouraged the full coverage of the textbook

content, the teachers in the sample schools in the Mashonaland East Province of Zimbabwe did not always do so. Carr (2006), Moffet and Corcoran (2011), and Perso (2006) all expressed the view that the parents often regarded the completion of all the content of the mathematics textbook as a sign of ‘good’ teaching, and an indication of getting their money’s worth. The teachers’ reasons for not covering all textbook content were that there was too much content in the textbook (see section 4.3.2.5), with inadequate time allocated for mathematics on the timetable. There was the possibility that the mathematics syllabus was not adequately covered if the textbook content coverage is below 75%, and the learners may not be fully prepared for the end-of-year examinations.

- **The teachers’ resistance to the textbook**

There existed resistance to the *Step in New Primary Mathematics Grade 7* textbooks. A number of teachers were not using these textbooks at all, or only used them to a limited extent. Instead, these teachers stuck to the *New Ventures in Mathematics*, even though they had only a very small number of copies of this textbook and an abundance of the *Step in New Primary Mathematics Grade 7* textbooks. This resistance was also evident from the informal interview with a school Headmaster (see section 4.3.3.4). In such cases the learners are deprived of the opportunity to own a mathematics textbook which they could have used in their own time. This also tends to perpetuate inequalities between schools.

5.4 THE IMPLICATIONS OF THE STUDY

Based on the study findings and from the literature review, the researcher proposes the following framework for the teachers’ effective utilisation of the mathematics textbooks and other mathematical resources. This can help to improve the quality of mathematics instruction.

5.4.1 Pre-service teacher training

As part of initial teacher training there should be a module on how mathematics textbooks can be

used in the classroom. This module could focus on:

- The importance of sequencing the topics in a manner that promotes the logical build-up of related mathematical concepts. This order need not be the same as the textbook topic sequence.
- Demonstrating that most mathematics problems can be solved in a variety of ways.
- The importance of showing worked examples to the whole class, and explaining all the steps that lead to the correct answer.

5.4.2 In-service professional development workshops

Staff development workshops should be held on a regular basis, either at district or circuit level. Teachers in a district or circuit could meet once monthly, after school on a week day or on a weekend, and at a venue that is most convenient to all. At these meetings teachers could work on matters of mutual interest such as the following:

- Identifying the errors in the mathematics textbook, correcting them and working out the correct answers. This is particularly useful when new curriculum materials are introduced to schools.
- Demonstrating to each other the possible methods of solving mathematics problems.
- Developing resource materials that complement the mathematics textbook.

5.4.3 Mathematics textbook use in the classroom

Teachers should place emphasis on interactive methodologies, in line with social constructivist philosophy. The teacher-learner interactions should focus on:

- Teachers working out exemplar solutions to problems on the board, explaining all the steps that lead to the correct answer.
- Teachers simplifying some difficult language used in the textbook, and engaging in language switching whenever necessary.
- Teachers should take into account the diverse cultures in a classroom, and use examples that most learners can identify with.
- Concerning learners who give incorrect answers, teachers should engage them in a

dialogue in order to diagnose the problem and take corrective action.

- Learners should be allowed an opportunity to ask questions, as well as to work out problems on the board.

The learner-learner interactions can take the form of pair work or small group work. Each group should be allowed to:

- Solve the textbook problems in their own ways, as long as they obtain the correct answers.
- Report back their solutions to the whole class.

Other important issues include the following:

- Composite classes: The work given to the learners should be graded by age. For example, the grade 6 learners in a composite class should do work from a grade 6 mathematics textbook, and not from a grade 7 textbook.
- Homework: Teachers should look for more questions from other sources if the mathematics textbook gives only a few homework questions.

5.5 RECOMMENDATIONS

In view of the findings presented and discussed in chapter 4, the researcher makes the following recommendations. These recommendations are divided into two categories, namely recommendations for improvement, and recommendations for further study.

5.5.1 Recommendations for improvement

5.5.1.1 Ensure a uniform textbook policy in all schools

There exists a need to review the schools' textbook policy in order to allow all the learners to take their textbooks home. The study revealed that policy in most rural and peri-urban primary

schools does not allow the learners to take the textbooks home, yet it was the learners from these communities who needed this learning resource the most. Taking textbooks home would translate into time saved by not re-issuing and collecting the textbooks daily, and would save time otherwise lost in copying work from the textbook or the chalkboard. This arrangement would accord equal access to textbooks for all the learners, whether rural or urban, and the teachers could then assign more work from the textbook to be done at home.

5.5.1.2 Provide regular teacher development programmes

A smooth transition from the old textbook should be provided through staff development workshops whenever new textbooks are introduced in the schools. This would help to make the teachers feel comfortable and confident in implementing the change. At the launch of the ETF workshops had not been arranged for the teachers on the use of these new textbooks, and this caused some anxiety and resistance. In order to be effective, Ogbonnaya (2011, p.143) suggested that these teacher development programmes should provide opportunities for sustained discussions of mathematics curriculum issues and the teachers' daily experiences, and should not be fragmented and non-cumulative. In other words, these teacher development programmes should be conducted on a regular and continuous basis.

5.5.1.3 Pay more attention to textbook use in teacher training programs

The component on teacher textbook use should be given greater prominence in pre-service and in-service teacher training programmes. This recommendation arises from the finding that textbook use is rarely discussed in teacher training modules, and yet it is at this stage that the teachers get to appreciate the need to use real life examples, to use the learners' mother tongue to explain difficult concepts, and to detect the learners' misconceptions in mathematics. Accordingly, greater co-operation between the schools and the teacher training colleges is recommended.

5.5.1.4 Upgrade the teachers' qualifications

Pre-service teacher training that culminates in the acquisition of a Bachelor of Education degree is recommended in the place of the present Diploma in Education. Evidence from this study indicated that besides their teaching experience, teachers with a bachelor's degree were more effective in their use of the new mathematics textbook and related resources.

5.5.1.5 Review policy on composite classes

The researcher recommends that a policy for composite classes be put in place to ensure that:

- teachers of composite classes have been specially trained to work in such environments;
- the teachers know how to use mathematics textbooks and other teaching resources; and
- the class sizes are within reasonable limits.

5.5.1.6 Improve information and communication technologies in the schools and in teacher training colleges

Textbook use can be enhanced by introducing computers with internet links at schools, colleges and resource centres. Importantly, some mathematics textbook concepts can be more easily explained and demonstrated using ICT than on the chalkboard. Difficult concepts can be better understood by the learners, for example those requiring 3-D visualisation (Ogbonnaya, 2011). It is therefore recommended that the Ministry of Education, Sport, Art and Culture sources funds for this worthy cause, or to speed up/prioritise ICT development in schools.

5.6.1.7 Improve the quality of the mathematics textbook as a matter of urgency

It was clear from the empirical study that this textbook uses language that is too difficult for most learners, and that it has some errors and omissions (see section 4.3.2.1). It is recommended

that revised editions of this textbook should be thoroughly edited for language challenges, errors and omissions before it is mass-produced for use in schools.

5.5.1.8 Group work findings should always be reported back to the entire class

In the lessons that were observed some teachers used group work, but did not insist on the groups reporting on their answers to the rest of the class. It is important that after the group discussions the teachers should ask all the groups to report back on their findings to the entire class, because this is necessary feedback. These sessions would also provide the teachers with the opportunities to correct any misconceptions reflected in the group reports, and/or to emphasise certain concepts.

5.5.1.9 Ensure the logical coverage of the content of the mathematics textbook

The coverage of the textbook topics should be guided by a logical sequence of concept development, instead of blindly following the order of the topics in the textbook as was the reported practice by some teachers in this study. An orderly or systematic coverage would help the learners to see the important relationships and continuity between the topics, and improve their conceptual understanding of the subject.

5.5.1.10 Encourage the use of alternative methods to solve problems

The learners should be exposed to, and allowed to choose the method they feel comfortable with to use in solving mathematical problems, as long as they can explain their strategies. As was mentioned by a number of respondents in this study, sometimes the methods used in the textbook were more difficult than what the learners can think of (see section 4.3.2.1). Constructivism advocates that the learners should be given the autonomy to think in diverse ways, provided the end result is the same (Carr, 2006).

5.5.2 Recommendations for further research

5.5.2.1 Language challenges in the *Step in New Primary Mathematics Grade 7* textbook

It was clear from this study that the mathematics textbook presented language challenges to the teachers and the learners. Therefore it is necessary to conduct research, specifically focusing on the language problems encountered by both the teachers and the learners when using this mathematics textbook. The research could also seek to engage the textbook authors on language matters, with a view to making the necessary changes in subsequent textbook editions.

5.5.2.2 The impact of using the *Step in New Primary Mathematics Grade 7* textbooks on opportunities for the teachers' learning

A study should be conducted which focuses precisely on what types of teacher learning occur as a result of using the new textbooks and how it changes their ways of teaching. This recommendation arises from the admission by some teachers in this study that the textbook has changed the ways they view and teach mathematics.

5.5.2.3 The extent of the coverage of the mathematics textbook

The researcher recommends that a study be conducted to establish the extent of mathematics textbook coverage by grade 7 teachers, and the likely effects. This recommendation is a follow-up to the finding that the teachers do not cover all the textbook content (see Table 4.14 and section 4.3.2.5).

5.5.2.4 Conduct similar research on a national scale

It is recommended that similar research be conducted on a national scale. A national study has the benefit that its findings could provide a fuller picture than the current one which used only a small sample in only one province, and the results could then be generalised.

5.6 LIMITATIONS

The scope of this study was limited to three districts in Mashonaland East Province, one of Zimbabwe's 8 non-metropolitan provinces due to financial and time constraints. As a full-time educator in South Africa, the researcher could spend only three weeks at the research sites, and met the costs of the study from personal resources. The requirement for persistent observation (see section 3.7.2) was not complied with, since the researcher only observed one lesson and conducted two interviews with each of the six teachers. However, the mixing of methods helped to overcome this shortfall. The mixed methods design used in this study was time-consuming and expensive. It is not possible to cover the whole country's primary schools in a study of this nature. Consequently it is difficult to generalise the findings of this study. However, the three districts covered are characteristic of the rest of the provinces in Zimbabwe, and the teaching practices are not likely to vary much.

5.7 CONCLUSION

The study described and evaluated the use of the *Step in New Primary Mathematics Grade 7* textbooks by teachers in the Mashonaland East Province in Zimbabwe. A literature review was carried out to discover the practices of teacher textbook use and factors that influence them. The review also focused on the likely impact of using new textbooks on the teaching and learning of mathematics. Data on the teachers' use of the textbooks were gathered from a sample of rural, peri-urban and urban primary schools by means of a mixed methods research design consisting of questionnaires, teacher interviews and lesson observations. The researcher presented and discussed the results of the empirical study in chapter 4.

Among the study findings were that there existed resistance as some teachers in the Mashonaland East Province preferred to use the few old textbooks instead of the new textbooks. This, in part, was attributable to the lack of workshops to appraise teachers on the *Step in New Primary Mathematics Grade 7* textbooks when they were introduced in the schools. There was little, if any, deliberate effort to expose the teachers to the appropriate methods of using mathematics textbooks in teacher training programmes. Up to 23% of the respondents expressed low

confidence levels in teaching all the topics in this textbook. Some of the teachers did not follow up on the learners' incorrect reading from the mathematics textbook, or on the learners' reasoning process when they gave incorrect answers. In a composite class this grade 7 textbook was used for both the grades 6 and 7 learners, despite the fact that grade 6 mathematics textbooks were readily available in the school. Generally, the sampled teachers neither indicated to the learners that textbook problems could be solved in a variety of ways, nor did they encourage the learners to solve these problems in their own ways. This contradicted the teachers' claims in the questionnaires and interview responses. The textbook presented several quality-related challenges, and it is imperative that these are attended to as a matter of priority. For example, the language used is difficult for many learners, and there are many errors in the textbook which may go undetected by both the teachers and the learners.

This was the first empirical study since the launching of the ETF textbook initiative, which investigated the practice of grade 7 mathematics textbook use by the teachers in the Mashonaland East Province of Zimbabwe. Based on the study findings, recommendations were made that should be useful to educators and other stakeholders both within and outside Zimbabwe.

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APPENDICES

APPENDIX A: Informed consent form

My name is Obediah Mumanyi. I am a student in the College of Education, University of South Africa. I am currently doing research on the use of the '*Step in New Mathematics Grade 7*' textbook by teachers in the Mashonaland East Province of Zimbabwe.

As a voluntary participant in this study you will be requested to do one or more of the following:

1. Complete a questionnaire.
2. Participate in individual interviews (duration: approximately 30 minutes) in which you will be asked questions related to how you use this grade 7 mathematics textbook. Interviews will be arranged at a time and venue most convenient to you, the participant.
3. Teach a mathematics lesson which the researcher will observe.

The information supplied by you as a participant in this research will be treated in the strictest confidence and will be used for academic purposes only. You are requested to give your honest responses to all the questions. The names of the participants and of their institutions will not be disclosed in the research report. Please do not write your name or the name of your school on the questionnaire.

The research's anticipated benefit will be a better understanding of how teachers use '*Step in New Primary Mathematics Grade 7*' textbooks and why they use them in that way, the challenges encountered in the use of these textbooks, and the impact of these new textbooks on teaching and learning. This will be of value not only to Zimbabwe but also to other countries where similar textbook projects have been (or will be) initiated. Another anticipated benefit is that the findings may lead to improved pre-service and in-service teacher training.

You are free to withdraw from the research project or from any part of the research at any moment. During the interviews you are free to decline to answer any of the questions asked. Should you decide to withdraw from the research, any information you have provided will be destroyed and will not form part of the research report.

Your signature is an indication that you are above 18 years of age, that you have read and understood the above, and are willing to take part in the research.

Thank you for agreeing to participate in this research project.

Signed:

Participant.....Date.....

Researcher: O. Mumanyi Cell: +26377232103

APPENDIX B: Teacher questionnaire

Dear Grade 7 Teacher

My name is Obediah Mumanyi. I am a student at the College of Education, University of South Africa. I am interested in understanding how Grade 7-teachers in the Mashonaland East Province use the *Step in New Primary Mathematics Grade 7* textbook in teaching and learning.

Your school has been selected, and has agreed to participate in this survey.

Please complete the questionnaire by responding to all the questions/statements in the spaces provided. All your answers will be kept confidential.

Your participation is greatly appreciated, and will help us to understand how to improve the contexts within which you work and how you use the mathematics textbooks in helping your students to learn.

Please hand the completed questionnaire in the envelope provided (sealed) to the Head of your school.

If you have any questions concerning the study, please feel free to contact me on telephone number +263772321038.

Thank you for your cooperation.

O. Mumanyi.

Section A

Biographical information

Please indicate your response by a tick (☑) in the appropriate box for each question

S/Number

--	--

1. Gender

Male	Female

2. Age

21-30 yrs.	31-40 yrs.	41-50 yrs.	Over 50 yrs.

3. Teaching experience

1-5 yrs.	6-10 yrs.	11-15 yrs.	Over 15 yrs.

4. Highest professional qualification

Certificate in Education	Diploma in Education	Bachelors' Degree	Masters' Degree	Other (Please Specify)
1	2	3	4	5

5. Type of school

Rural/ Farm	Peri-Urban	Urban
1	2	3

6. Responsible authority

Government	Rural Council	Town Council	Mission/Church	Other (Specify)
1	2	3	4	5

SECTION B

Please indicate the extent of your agreement/disagreement with the following statements about your use of the *Step inNew Primary Mathematics Grade 7* textbook using the following scale: Always=6 Very frequently=5 Occasionally=4 Rarely=3 Very rarely=2 Never=1

For each question/statement mark with a \surd the appropriate box that corresponds to the extent of your agreement/disagreement.

Item Number	Statement	Always	Very Frequently	Occasionally	Rarely	Very Rarely	Never
1.	My learners use their textbooks during the mathematics lessons to answer textbook-based questions.	6	5	4	3	2	1
2.	I assign homework from the textbook.	6	5	4	3	2	1
3.	My learners use the textbook after the mathematics lesson for homework assignments.	6	5	4	3	2	1
4.	I follow the sequence of the topics in the textbook.	6	5	4	3	2	1
5.	The textbook uses examples that the learners are familiar with.	6	5	4	3	2	1
6.	I use the revision exercises in the textbook to gauge the learner's computational and conceptual skills.	6	5	4	3	2	1
7.	I use examples from the learner's background when explaining concepts in the textbook.	6	5	4	3	2	1
8.	The language used in the textbook is easy for Grade 7-learners to understand.	6	5	4	3	2	1
9.	I simplify the language used in the textbook.	6	5	4	3	2	1
10.	I use the textbook to develop the learners' correct mathematical language.	6	5	4	3	2	1
11.	I encourage the learners to discuss the ideas in the textbook and to work in small groups.	6	5	4	3	2	1
12.	I encourage the learners to solve problems from the textbook in their own ways, as long as they can explain their reasoning.	6	5	4	3	2	1

13.	I am confident in teaching all the topics, using the <i>Step in New Primary Mathematics Grade 7</i> textbook.	6	5	4	3	2	1
14.	Regular professional development workshops on how to use mathematics textbooks in teaching are conducted in my province.	6	5	4	3	2	1
15.	I cover all the content in the textbook.	6	5	4	3	2	1
16.	I select what is important from the textbook and skip the rest.	6	5	4	3	2	1
17.	I incorporate activities from other sources that provide what is lacking in this textbook.	6	5	4	3	2	1
18.	The textbook has provided me with new ideas about mathematics and how it is taught and learned.	6	5	4	3	2	1
19.	The textbook makes teaching and learning Mathematics easier.	6	5	4	3	2	1
20.	The textbook makes the teaching and learning of Mathematics interesting.	6	5	4	3	2	1

SECTION C

Please write your answers to each question in the spaces provided after each question. All questions are in relation to the *Step in New Primary Mathematics Grade 7*.

1. What do you use this Mathematics textbook for? _____

How do you use this Mathematics textbook? _____

2. What are the strengths of this Mathematics textbook?

3. What aspects of this Mathematics textbook need to be improved?

4. What makes it difficult to use this textbook in teaching mathematics?

5. In your opinion, what needs to be done to make you a better user of this textbook?

6. Please write any other information that you think I should know concerning the use of this mathematicstextbook

THANK YOU.

APPENDIX C: Teacher interview questions

Thank you very much for agreeing to participate in this interview, and to have the proceedings audio-recorded. The interview will probably take 20 minutes. The information provided by you will remain confidential, and your name will not be divulged to anyone. You are free to decline to answer any of the questions in this interview or to terminate the interview at any stage should you feel like doing so.

1. How often do you use the *Step in New Primary Mathematics Grade 7* textbook? _____

2. In what ways do you use the textbook? _____

3. Do you use all the activities in the textbook?

4. Approximately what percentage of the textbook content do you cover in a year? _____.
5. In what way has this textbook influenced how you teach mathematics? _____

6. What are the strengths of this mathematics textbook? _____

7. What are the weaknesses of this textbook? _____

8. What other resources do you use to teach mathematics? _____

9. Why do you use these other resources? _____

10. Do you feel confident in teaching all the topics that are in this mathematics textbook? _____

11. How often do you use resources other than this textbook? _____

12. Have you been trained on how to use textbooks in teaching mathematics? _____

13. What factors in your work environment affect the way you use the textbook in teaching grade 7 mathematics? _____

14. To what extent have the *Step in New Primary Mathematics Grade 7* textbooks impacted on the teaching and learning of mathematics? _____

APPENDIX D: Observation tool

Teacher..... Time lesson begins.....
School..... Time lesson ends.....
Grade..... Textbook.....
Date of observation..... Chapter/Unit (pages).....
Lesson topic.....

BEFORE THE LESSON- Pre-observation Interview with Teacher

The following information will be collected in advance of the observed lesson- either as part of a conversation with the teacher prior to the lesson, or in asking the teacher to respond in writing prior to the lesson:

1. What is the major mathematical topic to be addressed in this lesson?
2. What are the major goals/objectives for this lesson?
3. In what way will the textbook be used in this lesson?

DURING THE LESSON – Lesson flow

I will describe/record the main activities that occur during the mathematics lesson and the amount of time devoted to each activity using the Lesson Flow Recording Sheet below. Both the teacher and the learner activities will be described, (at most, every 3 minutes).

If yes, what unit?Which pages?

A general description of how the students used the text (e.g. for exercises, to view diagrams, to look at a completed example, etc.)

Were materials other than the new mathematics textbook used by the students? YES NO

If yes, describe these materials.

3. Were the students given an assignment? YES NO

If yes, what materials were used? Textbookother (describe).....

How were these materials used?

To what extent did the new mathematics textbook influence the content and presentation of the lesson?

Content:A great dealSomewhatVery littleNot at all

Presentation:A great dealSomewhatVery littleNot at all

APPENDIX E

Request for permission to conduct educational research at selected primary schools in the Mashonaland East Province, Zimbabwe.

Halfway House Primary School
P.O. Box 224
Halfway House
1685
Gauteng, South Africa.

The Secretary for Education, Sport, Art and Culture
Ministry of Education, Ambassador House
Harare.

Dear Sir/ Madam

Request for permission to conduct educational research at primary schools in the Mashonaland East Province.

My name is Obediah Mumanyi, a doctoral student at the University of South Africa. My student number is 47235942. I am studying under the supervision of Dr.M.G. Ngoepe.

I request permission to conduct research in selected primary schools in the Mashonaland East Province.

My research topic is 'An evaluation of *Step in New Primary Mathematics Grade 7* textbooks in Mashonaland East Province,Zimbabwe.'

Attached please find a copy of permission/clearance from the University of South Africa to do the research.

Thanking you.

Yours faithfully

Obediah Mumanyi

APPENDIX F

Request for permission to conduct educational research at the primary schools.

Halfway House Primary School
P.O.Box 224
Halfway House, 1685
Gauteng, South Africa.

The School Head
_____ Primary School

Dear Sir/Madam

Request for permission to conduct educational research in your school

My name is Obediah Mumanyi, a doctoral student at the College of Education at the University of South Africa. I am studying under the supervision of Dr.M.G. Ngoepe.

I hereby request permission to conduct research at your school. I have already requested and have been granted permission to carry out research by the University of South Africa, and also by the Ministry of Education, Sport, Art and Culture, the Mashonaland East Province Education Directorate, and by your District Education Office. Attached please find copies of these letters.

My research topic is *An evaluation of Step in New Primary Mathematics Grade 7 textbooks in Mashonaland East Province, Zimbabwe.*

Selected Grade 7 teachers at your school will be requested to do at least one of the following, namely to

- a) complete a questionnaire, which will take not more than 15-20 minutes;
- b) participate in an individual interview (of approximately 30 minutes) in which they will be asked questions relating to how they use this mathematics textbook;
- c) teach a mathematics lesson which the researcher will observe.

Participation in this study is voluntary, and all the information obtained will be treated in the strictest confidence and will be used for academic purposes only. The participants can withdraw from the research at any time should they feel like doing so. The names of the participants and of their schools will not be disclosed in the research report. The teachers are not expected to write their names on the questionnaires.

The anticipated benefits of the research will be a better understanding of how teachers use this

textbook, and why they use it in that way, the challenges encountered in the use of this textbook, and the impact of this 'new' textbook on teaching and learning. This will be of value not only to Zimbabwe but also to other countries where similar textbook projects have been or will be initiated. Another benefit is that the findings may lead to improved pre-service and in-service teacher training, improved mathematics teaching and the improved quality of mathematics textbooks.

Your school will receive a summarised report of the research findings and recommendations after the study project has been completed.

Any queries concerning this study can be directed to me on telephone numbers +263772321038 or +27740257175.

Thank you for agreeing to your school's participation in this study.

Yours faithfully,
O. Mumanyi.

APPENDIX G



Research Ethics Clearance Certificate

This is to certify that the application for ethical clearance submitted by

O Mumanyi [47235942]

for a D Ed study entitled

**AN EVALUATION OF 'STEP IN NEW PRIMARY
MATHEMATICS GRADE 7' TEXTBOOKS IN MASHONALAND
EAST PROVINCE, ZIMBABWE.**

has met the ethical requirements as specified by the University of South Africa
College of Education Research Ethics Committee. This certificate is valid for two
years from the date of issue.

A handwritten signature in dark ink, appearing to read "CS le Roux".

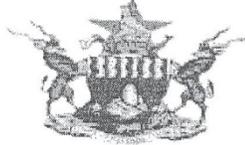
Prof CS le Roux
CEDU REC (Chairperson)
lrouxcs@unisa.ac.za

Reference number: 2013 Aug/47235942/CSLR

12 August 2013

APPENDIX H

all communications should be addressed to
"The Secretary for Education Sport and Culture"
Telephone: 734051/59 and 734071
Telegraphic address : "EDUCATION"
Fax: 794505



ZIMBABWE

Ministry of Education, Sport,
Arts and Culture
P.O Box CY 121
Causeway
Zimbabwe

03 JANUARY 2012

O BESI AH MUMANYI

42 COLIN AVENUE, LETOMBO PARK

P.O. AMBY, HARARE

RE: **PERMISSION TO CARRY OUT RESEARCH IN THE MINISTRY OF
EDUCATION, SPORT, ARTS AND CULTURE.**

Reference is made to you application to carry out research in the Ministry of Education,
Sport, Arts and Culture institutions on the title:

How Do GRADE 7 TEACHERS IN MASHONALAND EAST
PROVINCE OF ZIMBABWE USE THE NEW MATHEMATICS
TEXTBOOKS IN TEACHING AND LEARNING ?

Permission is hereby granted. However, you are required to liaise with the Provincial
Education Director responsible for the schools which you want to involve in your
research.

You are also required to provide a copy of your final report to the Ministry since your
study is instrumental in the development of education in Zimbabwe.

T.L. Mudenha

T.L. MUDENHA (MRS)

for: **SECRETARY FOR EDUCATION, SPORT, ARTS AND CULTURE**



APPENDIX I

Reference: P1 MUMANYA .0

E. C. No.:

All communications should be addressed to
"The Provincial Education Director
Mashonaland East Province"
Telephone: 0279-24811/4 and 24792
Telex :
Fax: 079-24791



Ministry of Education, Sport & Culture
Mashonaland East Province
P.O. Box 752
Marondera
Zimbabwe

H.R. OFFICER (DISCIPLINE)
MIN OF EDU SPORT & CULTURE
MASH EAST PROVINCE
2012 -01- 0 6
P.O. BOX 752, MARONDERA
ZIMBABWE TEL. 0279-24811/4

Mr/Mrs/Miss OBEDIAH MUMANYA
42 COLIN AVENUE
LEDOMBO PARK, HARARE

PERMISSION TO CARRY OUT RESEARCH IN SCHOOL FOR EDUCATIONAL
PURPOSES: MR/MRS/MISS OBEDIAH MUMANYA E. C. NO.
STUDENT I. D. 47235942 HEAD/TEACHER ATSCHOOL

Reference is made to your minute dated 06 DECEMBER 2011.
Please be advised that permission has been granted that you carry out research work in
our schools. You are accordingly being asked to furnish the Ministry with information
about your findings so that we share the knowledge for the benefit of the system as well
as our nation at large.

We wish you all the best and hope to hear from you after completing your project work.

HUMAN RESOURCES OFFICER – DISCIPLINE
FOR PROVINCIAL EDUCATION DIRECTOR
MASHONALAND EAST PROVINCE

/mm

H.R. OFFICER (DISCIPLINE)
MIN OF EDU SPORT & CULTURE
MASH EAST PROVINCE
2012 -01- 0 6
P.O. BOX 752, MARONDERA
ZIMBABWE TEL. 0279-24811/4